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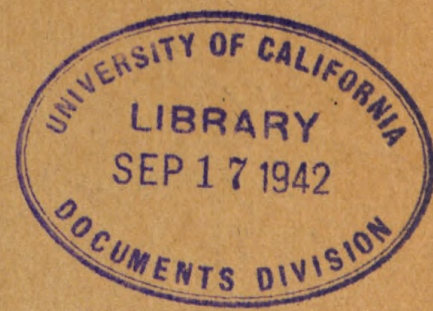
TECHNICAL MANUAL



FIELD ARTILLERY INDIVIDUAL AND
UNIT TRAINING STANDARDS

November 18, 1941

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FIELD ARTILLERY INDIVIDUAL AND UNIT TRAINING .2
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Prepared under direction of the
Chief of Field Artillery

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SECTION I

GENERAL

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1. **Scope.**—*a. General.*—This manual gives a list of the subjects in which the basic soldier, the specialist, the noncommissioned officer, and the organization should be qualified. The detailed guide for training is found in the manuals published on each subject.

b. References.—References to Field Manuals, Technical Manuals, training films, film-strips, and other appropriate training aids are given in each paragraph. "Par. 6" means that all training aids indicated in paragraph 6 should be added to any specifically mentioned in the paragraph under consideration.

c. Basic training.—The subjects included under section II are those to be given all field artillery soldiers and are to be covered during the initial period of training (MTP 6-1). At the end of this period of training each man should be sufficiently trained to be rated as a second class gunner.

d. Specialist training.—(1) The subjects included under section III for each specialist are in addition to those in section II and are given to men who have been selected for specialized training. Such training is to be given during the initial period (MTP 6-1). Upon completion of this training, and after a short period of training with the battery, the specialist should be sufficiently trained to be able to qualify as a first class or expert gunner (FM 6-125).

(2) The training specified for noncommissioned officers is given to those soldiers who have the qualifications of leadership and experience normally required of men holding noncommissioned grades.

e. Unit training.—Each unit will be trained to function efficiently under all conditions of service.

2. Duties of commanders of training organizations.—Commanders of training centers and other training units will study each list of subjects (in conjunction with the appropriate Training Manuals) in which they are to qualify individuals, and will have detailed schedules of training prepared. Each subject will be given its proper weight with respect to the whole and allotted its appropriate number of hours. Progress tests will be given at frequent periods. At the end of the training period, each soldier is qualified to work in an organization with a reasonable degree of efficiency, or is held for further training.

3. Duties of commanders of troops.—*a. General.*—Commanders of troops will fit men into their units in positions for which they appear to be best qualified. The training then continues under the close personal supervision of organization commanders and their commissioned and noncommissioned assistants. By constant training of the most practical nature that can be devised, individuals will be trained in their duties until they function automatically and efficiently under all degrees of stress and adverse conditions. During this training period, the necessary readjustments will be made in assignments to place each man in the position for which he demonstrates the greatest adaptability.

b. Training in several positions.—As an individual demonstrates his proficiency in one position, he will be given alternative assignments for training, particularly in higher positions. This will sustain the interest of the individual and at the same time provide the necessary reserves to replace casualties and to fill cadres.

4. Organization qualifications.—Each organization and subdivision thereof will be given frequent tests by superior commanders to determine progress and efficiency. Tests will take the form of

field exercises of the most realistic form practicable. All available time and facilities will be utilized to the utmost to assure effective training in offensive and defensive combat. Particular attention will be given to active and passive defense against air and mechanized attacks. The objective is to insure units entering battle with a high degree of combat efficiency.

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5. Animal transport. (FM 6-5, 25-5; TF 2-64, 6-3, 6-4; FS 2-1.)

- a. Saddling and bridling.
- b. Harnessing and unharnessing.
- c. Management of the pair in draft.
- d. Nomenclature, adjustment, and care of harness.
- e. Disposition of harness in garrison and field.
- f. Duties of the driver on the march.

6. Animal management. (FM 6-5, 25-5; TF 2-64, 2-66; FS 2-1.)

- a. Care of animals.*—(1) Grooming.
- (2) Watering and feeding.
- (3) Police of stables and picket lines.
- b. Equitation.*—(1) Mounting and dismounting.
- (2) Position of the soldier mounted.
- (3) Reins and the aids.
- (4) Riding at walk, trot, and gallop.

7. Camouflage and concealment. (FM 5-20, 6-130; FS 5-3, 5-10.)

- a. Knowledge of the necessity for concealment.*
- b. Camouflage discipline.*
- c. Knowledge of the use of camouflage equipment within the battery.*
- d. Natural and artificial materials used.*
- e. Principles of camouflage.*

8. Cannoneer drill. (FM 6-series, service of the piece; TF 6-series, duties.)

a. Familiarity with firing, elevating, and traversing mechanism, sights, quadrant, fuze setters, ammunition, and fuzes.

b. Duties of all members of the gun squad.

9. Communication. (FM 24-5; FS 6-1, 11-1.)

- a. Test of telephone.*
- b. Connecting a telephone and sending a simple message.*
- c. Make a connection through switchboard as switchboard operator putting a call through.*
- d. Be familiar with proper laying and picking up wire.*
- e. Making wire splices.*
- f. Carry a ten word oral message.*
- g. General knowledge of means of communication used.*

10. Courtesies, customs, and discipline. (FM 21-50, 21-100; MCM; TF 11-157.)

- a. Salutes, reasons for and proper rendering of.*
- b. Courtesies in conversation.*
- c. Reporting and delivering messages.*
- d. Relationship between officers and men.*
- e. Military grade and insignia.*
- f. The flag of the United States; honors to the National Anthem and to colors and standards.*
- g. Ceremonies.*
- h. Award and supply of decorations.*
- i. Obedience to orders.*
- j. Articles of War.*

k. Regulations and orders.

l. Action in case of refusal of medical, surgical, or dental treatment.

m. Authority for exercising command.

n. Commands appropriate to each grade.

o. Disciplinary powers of commanding officers.

p. Political activities of military personnel.

q. War Department's attitude toward discussions of military policy.

11. Defense against aircraft. (FM 5-20; TF 7-108; FS 4-2; FM 30-30, 30-35.)

a. Knowledge of weapons used against aircraft.

b. Ability to identify types of friendly and enemy aircraft.

c. Knowledge of the passive means of defense against aircraft (concealment, dispersion, and restriction of movement).

12. Defense against armored vehicles. (FM 5-30; TF 5-145, 5-146, 5-148, 5-149; FS 5-6; FM 30-40, 30-42.)

a. A general knowledge of armored vehicles and their characteristics.

b. Ability to identify types of friendly and enemy armored vehicles.

c. A general knowledge of active and passive methods of anti-mechanized defense.

d. Knowledge of the use of natural and artificial barriers.

e. Knowledge of weapons used in antimechanized defense.

f. Ability to place and camouflage antitank mines.

g. Knowledge of vulnerable parts of enemy armored vehicles.

13. Defense against chemicals. (FM 21-40; TF 3-2, 3-216 to 219; FS 3-1 to 7.)

a. Gas mask drill—putting on, fitting, adjusting, and testing.

b. Methods of projecting chemicals.

c. Effect of weather and terrain on the use of chemicals.

d. Individual and collective protection.

e. Marching and drilling in masks.

f. Kinds of chemicals, their action, identification, how used, first-aid treatment, and protection required.

g. Decontamination of areas and equipment.

h. Protection of animals.

i. Test for gas.

j. Duties of gas sentinel.

k. Construction and maintenance of gas proof shelter.

l. Organization for defense against chemical attack.

14. Dismounted drill. (FM 6-5, 22-5; TF 7-248, 7-249.)

Execute with accuracy, precision, and understanding the positions and movements, individually and collectively, as prescribed in the *school of the soldier*.

15. Equipment. (FM 21-15.)

- a. Knowledge of personal equipment, its use, and adjustment.
- b. Care of equipment and proper methods of cleaning.
- c. Prescribed markings.
- d. Display for inspection.
- e. Penalty for defacing, losing, or selling.
- f. Method of replacement.
- g. Field packs and rolls.
- h. Tents, single and double shelter, small wall, large wall, and pyramidal:

- (1) Pitching.
- (2) Ditching.
- (3) Beds.
- (4) Mosquito bar.
- (5) Disposal of clothing and equipment.
- i. Latrine screen pitching.

16. Fire-control instruments. (TM 6-220; TF 6-111, 6-112.)

- a. Names of fire-control instruments, their purpose, and proper care.
- b. Setting up and taking down all types.
- c. Measurement of angles with each.

17. Field exercises. (FM 5-15, 5-20, 6-20, 6-130, 21-40, 21-100; TF 6-15.)

Practical application of all technical training in the development of teamwork in various tactical situations by day and night to include—

- a. Occupation of position.
- b. Defense against chemical, ground, and air attacks.
- c. Field fortifications.
- d. Camouflage and camouflage discipline.
- e. Field sanitation, first aid, and personal health.
- f. Care and maintenance of matériel.
- g. Firing service ammunition.

18. First aid. (FM 21-10, 21-100; TF 8-33, 8-150; FS 8-7.)

- a. Object of first aid and general instructions to be used in its application.
- b. Basic rules of first aid.
- c. First-aid packet and its use.

- d.* Bandages and slings.
- e.* Cuts, scratches, and minor injuries.
- f.* Control of bleeding and use of tourniquets.
- g.* Care and treatment of fractures.
- h.* Poisoned wounds and bites.
- i.* Fainting, sunstroke, shock, heat exhaustion, and freezing.
- j.* Burns—including chemical.
- k.* Artificial respiration—drowning, electrical shock, suffocation.
- l.* Litters, their care and use.
- m.* Improvised methods of carrying.
- n.* Pain in abdomen and precautions to be observed.
- o.* Apoplexy, intoxication, wood-alcohol poisoning, and fits.
- 19. Field fortifications.** (FM 5-15; 6-130.)

a. How to construct the various field fortifications used by the field artillery.

b. The value of simple field fortifications as protection from both artillery and small-arms fire.

c. The soldier should have constructed one of the simple field fortifications and should have witnessed the construction of all of them.

d. Knowledge of road blocks and their construction.

20. Hygiene and sanitation. (FM 21-10, 21-100; TF 8-154, 8-155; FS 8-1 to 6.)

a. Necessity for hygiene and sanitation.

b. General knowledge of how diseases are transmitted.

c. Causes of diseases.

d. Prevention of diseases.

e. Importance of early medical treatment.

f. Care of teeth.

g. Care of feet.

h. Internal and external cleanliness.

i. Necessity for proper food, exercise, sleep, and cleanliness to maintain health and proper physical condition.

j. Methods of water purification and protection of water supply.

k. Disposal of waste.

l. Cleaning and sterilization of eating utensils.

m. Thorough knowledge of prevention of venereal diseases.

21. Interior guard duty. (FM 26-5.)

a. Reason for interior guard duty.

b. Orders for sentinels and explanation thereof.

c. Procedure—halts, advances, calls, salutes, and honors.

d. Duties of all members of the guard.

- e.* Guarding prisoners.
- f.* Stable and park guards.
- g.* Action in case of fire or disorder.

22. Map reading and use of compass. (FM 21-25, 21-30; TF 5-12; FS 5-1.)

- a.* Common conventional signs.
- b.* Read scale of map.
- c.* Measure a map distance.
- d.* Determining map elevations.
- e.* Orient a map or photo with respect to the ground.
- f.* Locate a point on a map or photo.
- g.* Locate a point on the ground from a map or photo.
- h.* Use of compass by day and by night.
- i.* Orient a map or photo with a compass.
- j.* Follow a given direction by compass.

23. Marches, camps, and bivouacs. (FM 6-5, 21-100, 21-10, 100-5.)

- a.* Preparation.
- b.* March discipline.
- c.* Camp sites.
- d.* Kinds of shelter.
- e.* Personal care and comfort.
- f.* Concealment and cover.
- g.* Care and disposition of transport (animal or motor).
- h.* Care and disposition of matériel and equipment.
- i.* Mounted and dismounted marches and bivouacs.

24. Matériel. (Par. 31; TM; FM 6-series, service of the piece; TF 6-series, duties, 9-30, 9-31, 9-57; FS 9-4, 9-17.)

- a.* General nomenclature and functioning of guns and carriages issued to the organization.
- b.* Nomenclature and marking of projectiles and fuzes used.
- c.* General nomenclature and functioning of antitank and antiaircraft weapons issued to organization.
- d.* General cleaning and care of guns before and after firing.
- e.* Care and precautions in storing and handling ammunition.

25. Motor-vehicle driving, care, and maintenance. (FM 25-10; TF 6-102, 25-76; FS 10-39, 10-43.)

- a.* Safety precautions and signals.
- b.* Driver, operation, and maintenance.
- c.* Drive through a simple specified course.
- d.* Check oil, fuel, radiator, tires, battery, and brakes.
- e.* Principles of lubrication.

26. Organization. (FM 6-5, 21-100, 6-110; FS 6-8.)

- a.* A general knowledge of the organization of the Army.
- b.* Knowledge of types of field artillery and purpose of each type.
- c.* Organization of his own regiment, battalion, and battery, and the names of the respective commanders.
- d.* Designation of all major units of his division or similar unit.

27. Physical training. (FM 21-20.)

- a.* Setting up exercises.
- b.* Mass games.
- c.* Climbing ropes, poles, and scaling walls.
- d.* Swimming.
- e.* Boxing and wrestling.
- f.* Baseball, soccer, tug o' war, etc.

28. Rail movement. (FM 6-130, 25-5.)

- a.* Packing harness in sacks for shipment.
- b.* Packing personnel equipment for shipment.
- c.* Rules of conduct for individuals during rail movement.
- d.* Loading matériel.
- e.* Loading animals.
- f.* Care of animals during movement.

29. Reconnaissance and security. (FM 21-45, 21-100.)

- a.* Observation of a sector for items of military significance.
- b.* Write a field message and transmit written and oral message.
- c.* Read maps and photos.
- d.* Use field glasses.
- e.* Proper use of concealment in observing and crossing an area.
- f.* Duties of rocket and other sentinels.

30. Route marking. (FM 6-20.)

- a.* Procedure in route marking by day and by night.
- b.* Elementary map reading.
- c.* Use of signals and signs.
- d.* Receiving and transmitting oral and written messages.

31. Secondary weapons, their use and care.—*a.* Automatic pistol and rifle. (FM 23-10, 23-35; FS 7-5, 7-6, 7-16, 7-17, 7-38.)

(1) Ability to disassemble and assemble as authorized the using arms.

- (2) The nomenclature, care, and cleaning.
- (3) The safety devices.
- (4) Safety precautions in firing.
- (5) Execution of the manual.
- (6) Qualification in the record course.

b. Machine gun, caliber 50 Browning M2. (FM 23-65.)

- (1) Ability to disassemble and assemble as authorized the using arms.
- (2) The nomenclature, care, and cleaning.
- (3) A comprehensive understanding of the operation of the machine gun.
- (4) Safety precautions in firing.
- (5) Causes of stoppages and the remedial actions.
- (6) Knowledge of the kinds of ammunition and of its care, handling, and preservation.
- (7) The preliminary gunner's firing test.

c. 37-mm gun, antitank M4. (FM 23-70; FS 7-68.)

- (1) Ability to disassemble and assemble as authorized the using arms.
- (2) The nomenclature, care, and cleaning.
- (3) A comprehensive understanding of the operation of the gun and carriage.
- (4) Safety precautions in firing.
- (5) Causes for stoppages and the remedial actions.
- (6) Knowledge of the kinds of ammunition and of its care, handling, and preservation.
- (7) The gunner's preliminary firing test.

32. Uniforms. (FM 21-15, 21-100.)

- a.* The prescribed uniforms.
- b.* Wearing of the uniform.
- c.* Recognition of all insignia, decorations, and their significance.
- d.* Care and appearance.
- e.* Allowance.
- f.* Replacement.
- g.* Penalty for defacing, losing, or selling.

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ADMINISTRATIVE AND CLERICAL

33. Battery clerk. (AR 1-15, 35-series, 340-15, 345-series, 850-150; FM 6-5, 6-20, 6-130, 21-5, 21-6, 30-25; TM 12-250; MCM.)

a. Knowledge of the use of Army Regulations and War Department bulletins and circulars.

b. Use of typewriter and adding machine.

c. Grammar.

d. Knowledge of authorized abbreviations.

e. Military correspondence and battery orders.

f. Preparation of all blank forms used in the battery.

g. Knowledge of field desk and contents.

h. Detailed knowledge of the battery filing system.

34. Headquarters clerk. (Par. 33; FM 21-26; DFC.)

a. Knowledge of the use of Army Regulations, War Department bulletins and circulars.

b. Use of typewriter, adding machine, and duplicating machine.

c. Grammar.

d. Knowledge of authorized abbreviations.

e. Military correspondence.

f. Preparation of all blank forms used in the headquarters.

g. Publishing orders.

h. Manual for Courts-Martial.

i. Preparation of reports of boards, courts-martial proceedings, and reports of survey.

j. Use of codes and cipher device.

k. Knowledge of maps, and their care and filing.

l. Detailed knowledge of the headquarters filing system.

35. Personnel sergeant (regimental and battalion). (Par. 34.)

- a. Qualification as *battery clerk* and *headquarters clerk*.
- b. Familiarity with current regulations regarding personnel sections.
- c. Ability to instruct in the duties listed above.

36. First sergeant. (Pars. 33, 50, 77, 82, 116; FM 6-40, 21-100.)

a. *Gun or howitzer battery*.—(1) General knowledge of the duties of all noncommissioned officers in the battery, and detailed knowledge of the duties of the *mess, supply, and motor (stable) sergeants, and battery clerk*.

- (2) Battery administration.
- (3) Duties of the executive.
- (4) Field sanitation.
- (5) Care, maintenance, storage, and packing of matériel and equipment.
- (6) Billeting, camps, marches, and bivouacs.
- (7) Motor, rail, and water movements.
- (8) Organization of his battery and other units of the battalion (regiment).

(9) Organization of rear echelon for administration and supply, and defense against air, ground, and gas attack.

b. *Headquarters battery*.—(1) Same as a above, except (3).

(2) Operation of fire-direction center.

(3) Communication system of the battalion (regiment, brigade).

c. *Service and ammunition battery*.—(1) Same as a above, except (3) and (9).

(2) Supply, accounting, care, and storage of ammunition in the field.

(3) Operation of field train and organization of battalion rear echelon for administration, supply, and defense against air, ground, and gas attack.

37. Sergeant major (regimental and battalion). (Pars. 34, 77, 82, 116; FM 6-40, 21-100, 30-21.)

a. Qualification as *first sergeant* and *personnel sergeant (regimental and battalion)*.

b. Knowledge of operation of the fire-direction center.

c. Interpretation of maps and air photos.

d. Knowledge of installation, maintenance and use of field artillery communication systems.

e. Knowledge of firing and computation of firing data.

- f.* Organization of the Army to include the division.
- g.* General knowledge of tactical employment of field artillery and methods of defense against air, ground, and gas forces.

AMMUNITION

38. Corporal (ammunition, chemical, and camouflage). (FM 5-20, 21-40, 6-130; TM 3-205, 9-1900; TR 1355-75A, 155A, 155B, 240A; TF 1-221, 3-2; FS 3-1 to 7, 9-16, 9-17.)

- a.* Receiving, storing, protecting, and accounting for ammunition.
- b.* Knowledge of markings on ammunition, and weights and contents of containers.
- c.* Authorized ammunition loads for various vehicles.
- d.* Routine of ammunition supply, and keeping records, and making reports.
- e.* Inspection of gas masks.
- f.* Gas mask drill.
- g.* Warning systems.
- h.* Identification of chemicals.
- i.* Rules of gas discipline.
- j.* Use of gas shelters.
- k.* Use of decontaminating agents.
- l.* First aid for those injured by chemicals.
- m.* Use of natural camouflage.
- n.* Use of issue camouflage equipment.
- o.* Rules of camouflage discipline.
- p.* Principles of shade and shadows in camouflage.

39. Chief of ammunition section (battery). (Par. 78; FM 5-30, 6-130, 21-25; TM 3-205, 9-1900; TR 1355-75A, 155A, 155B, 240A; TF 1-221, 9-58; FS 9-16, 9-17.)

- a.* Qualification as *chauffeur* and in *a* to *d*, inclusive, *corporal (ammunition, chemical, and camouflage)*.
- b.* Post and duties of all members of his section.
- c.* Knowledge of camouflage and field fortifications.
- d.* Advanced knowledge in map reading.
- e.* Ability to train all members of his section in their duties.

40. Clerk, ammunition (sergeant). (FM 6-130; TM 3-205, 9-1900; TR 1355-75A, 155A, 155B, 240A; FS 9-16, 9-17.)

- a.* Qualification in *a* to *d*, inclusive, *ammunition corporal*.
- b.* Knowledge of a unit of fire for battery and battalion.
- c.* Knowledge of normal ammunition loads carried in the battalion.
- d.* Methods of drawing ammunition against established credits.
- e.* Ability to make all records and reports.

ANIMAL TRANSPORT

41. Drivers (horse and horse-drawn). (Par. 5; FM 21-40.)

- a.* Special instruction in care, feeding, and watering, under all conditions of service.
- b.* Harnessing and unharnessing; adjustment, fitting, disposition, and care of harness.
- c.* Maneuvers limbered and arm signals.
- d.* Difficult draft and negotiating obstacles.
- e.* Principles of marching and march discipline.
- f.* First aid to horses with particular attention to combat injuries.
- g.* Conduct during an air attack.
- h.* Protection of animals against chemicals.

42. Drivers (pack). (FM 6-110, 21-40, 25-5; TF 2-64; FS 2-1.)

- a.* Special instruction in care, feeding, and watering, under all conditions of service.
- b.* Packing and unpacking; adjustment, fitting, and disposition of pack saddle.
- c.* Maneuvers packed and arm signals.
- d.* Negotiating difficult terrain.
- e.* Principles of marching and march discipline.
- f.* First aid to animals with particular attention to combat injuries.
- g.* Packing various type loads.
- h.* Conduct during an air attack.
- i.* Protection of animals against chemicals.

43. Packer (pack artillery). (FM 6-110, 25-5.)

- a.* Special instruction in nomenclature, fitting, use, and care of pack saddle equipment.
- b.* Preparation of cargo into packs for loading.
- c.* Ability to tie and splice ropes and cords; and to form all hitches used in packing.
- d.* Ability to sling and lash loads; and to remove loads.
- e.* Train saddle and pack animals.

44. Cargador (pack artillery). (Pars. 42, 43.)

- a.* Qualification as *driver* and *packer* (*pack artillery*).
- b.* Ability to set up loads according to the strength and condition of the animals.
- c.* Make necessary repairs to pack saddles and other equipment.
- d.* Determine by observation of the march which loads need adjustment.
- e.* Determine by observation the condition of animals on the march.

f. Direct the disposition of care and protection of loads, pack saddles, and equipment in camp as directed.

g. Supervise packers in loading and unloading.

h. Assistant to packmaster and capable of taking over his duties during his absence.

45. Packmaster. (Pars. 42, 43.)

a. Qualification as *driver*, *packer*, and *cargador* (*pack artillery*).

b. Ability to train members of his section.

46. Horseshoer. (FM 6-5, 25-5; TM 2-220; FS 10-41.)

a. Nomenclature, use, and care of blacksmith's tools.

b. Anatomy and diseases of the animal's foot.

c. Preparation of the hoof.

d. Shaping and fitting all types of shoes.

e. Orthopedic shoeing.

f. Shoeing refractory animals.

g. Welding.

47. Saddler. (FM 6-5, 25-5; TM 2100-25.)

a. Nomenclature, use, and care of saddler's tools.

b. Leather work in general, and care and repair of harness in particular.

c. Repair of web equipment and tentage.

48. Wagoner. (FM 6-5, 25-5; TF 2-64; FS 2-1.)

a. Special instruction in care, feeding, and watering, under all conditions of service.

b. Special instruction in harnessing and unharnessing, adjustment, fitting, disposition, and care of harness.

c. Difficult draft and negotiating obstacles.

d. Loading wagons.

e. Care, repair, and lubrication of wagons.

f. Principles of marching and march discipline.

g. First aid to animals.

h. Conduct during an air attack.

49. Stable orderly. (FM 21-40, 25-5; TM 2-220; TF 2-64; FS 2-1.)

a. Special instruction in care, feeding, and watering of animals.

b. Stable management and sanitation.

c. Forage and forage reports; animal sick report and shoeing record.

d. The anatomy of the horse (mule).

e. General principles of horseshoeing.

f. Common diseases and their treatment.

- g.* Principles of animal training and conditioning.
- h.* Treatment of injuries.
- 50. Stable sergeant.** (Pars. 46 to 49, incl.)
 - a.* Qualification, but to a much higher degree, as specified for *stable orderly*.
 - b.* Knowledge of duties of the *horseshoer, saddler, and wagoner*.

COMMUNICATION

- 51. Visual signalman.** (FM 24-5; TM 6-230; FS 11-1.) In addition to the qualifications of his assignment:
 - a.* Transmit and receive semaphore signals of 50 characters per minute.
 - b.* Transmit with a signal lamp or similar device at the rate of 8 five-letter words per minute.
 - c.* Familiarity with artillery fire-control code.
 - d.* Location and operation of visual stations under all conditions of service.
- 52. Messengers and agents.** (FM 21-25, 21-100, 24-5; TF 5-12; FS 5-1).
 - a.* Receive and deliver simple oral messages and orders to include information regarding:
 - (1) Tactical dispositions.
 - (2) Missions.
 - (3) Fire direction.
 - (4) Marching and routes.
 - (5) Administrative arrangements.
 - b.* Assist in reconnaissance and act as a guide.
 - c.* Specialization in map reading.
- 53. Communication chief.** (Par. 9; FM 6-5, 6-20, 6-40, 21-25, 21-40, 25-5, 25-10, 30-21; TF 5-12; FS 5-1, 5-2, 6-2.)
 - a.* Interpretation of maps and air photos.
 - b.* Theory and practice of wire systems and equipment; installation, operation, and maintenance.
 - c.* Theory and practice of radio systems and equipment; installation, operation, and maintenance.
 - d.* Theory and practice of visual systems and equipment; installation, operation, and maintenance.
 - e.* Army organization to include the division or similar unit of which his battery is a part.
 - f.* General knowledge of tactical employment of field artillery.
 - g.* Ability to supervise training of wire section and radio section.

WIRE

54. Lineman. (Par. 9; FM 6-5, 21-25, 21-100; TM 11-360; TF 5-12; FS 5-1.)

- a.* Use, care, and maintenance of all wire-laying equipment.
- b.* Laying and picking up wire over all types of terrain.
- c.* Protection of wire lines.
- d.* Connection of telephones and switchboards.
- e.* Repair and maintenance of telephone lines.
- f.* Ability to operate telephones and switchboards.
- g.* Map reading.
- h.* Line route maps.
- i.* Phonetic alphabet.
- j.* Field messages.

55. Telephone operator. (Par. 54; TM 11-333.)

- a.* Qualification as *lineman*.
- b.* Nomenclature of telephone.
- c.* Knowledge of telephone and electrical principles involved.
- d.* Test for and correction of common telephone trouble.

56. Switchboard operator. (Par. 55; TM 11-330.)

- a.* Qualification as *telephone operator*.
- b.* Nomenclature of switchboard.
- c.* Knowledge of switchboard circuits and electrical principles involved.
- d.* Switchboard procedure.
- e.* Traffic and circuit diagrams.
- f.* Staff organization of unit and location of associated units.
- g.* Ability to simplex wire circuits.

57. Signal corporal. (FM 6-5, 21-25, 21-100, 24-5, 25-10; TM 11-330, 11-333, 11-360; TF 5-12, 6-102, 25-76; FS 5-1, 6-1, 10-39, 10-43, 11-1.)

- a.* Qualification as *switchboard operator*.
- b.* Thorough and complete knowledge of wire-laying devices (including their maintenance).
- c.* Qualified driver.
- d.* Ability to organize the work of his crew.
- e.* Army organization to include the division or similar unit of which his battery is a part.

58. Signal sergeant. (Par. 57; FS 5-2.)

- a.* Qualification as *signal corporal*.
- b.* Ability to appreciate terrain with a view to laying wire lines over the most favorable routes.

- c.* Ability to organize the work of his section.
- d.* Ability to instruct all men in his section in the proper and systematic performance of their duties.

RADIO

59. Radio operator.—*a. SCR 193-A and 194.* (FM 6-5, 6-20, 24-5; TR 1210-52, 1210-73; TF 1-229.)

- (1) Nomenclature, operation, maintenance, and care of set.
- (2) Phonetic alphabet.
- (3) Radio telephone procedure.

b. SCR 161, 178, and 245. (Pars. 51, 59*a*; TM 6-210, 6-230, 11-351, 11-454; TR 1210-21, 1210-50.)

- (1) Qualification as *radio operator* in *a* above.
- (2) Theoretical and practical electricity and radio.
- (3) Mechanical knowledge of radio sets, and ability to make minor adjustments and repairs.
- (4) Radio telegraph procedure and net operation including keeping of station log and servicing messages.
- (5) Location, occupation, and protection of radio stations.
- (6) Transmit and receive 15 code groups of 5 letters each per minute for 3 minutes, transcribing the received signals in the prescribed form of printing.

- (7) Artillery fire-control code.
- (8) Decode messages received in air-ground liaison code.
- (9) Installation, operation, and maintenance of telegraph set TG-5-A.

- (10) Qualifications as *visual signalman*.
- (11) Use of panels.

60. Radio technician. (Pars. 59*a* and *b*; TR 1215-4.)

- a.* Qualification as *radio operator*.
- b.* Specialized knowledge of the use, care, and maintenance of radio sets.
- c.* Ability to make adjustments and repairs on radio equipment issued to his section.

61. Radio sergeant. (Par. 60; FM 21-25, 21-30, 30-21.)

- a.* Qualification as *radio operator* and *radio technician*.
- b.* Ability to appreciate terrain with a view to locating radio stations in the most favorable locations.
- c.* Army organization to include the division or similar unit of which his battery is a part.
- d.* Ability to organize the work of his section.

- e. Ability to take over the duties of any man in his section.
- f. Ability to instruct all men in his section in the proper and systematic performance of their duties.
- g. Ability to interpret and evaluate maps and air photos.
- h. Ability to supervise adjustments and repairs on radio equipment issued to his section.

MESSAGE CENTER

62. Message center clerk. (FM 6-5, 6-20, 24-5; DFC 4-T1; AGL-T1; TM 6-230; TM 11-450.)

- a. The complete communication system of his own unit and those with which it may transact official business.
- b. The staff organization of his own unit, and a general knowledge of the organization of associated units.
- c. Enciphering and deciphering rapidly.
- d. Ability to keep all message center records.
- e. Selection of various methods of transmitting messages.
- f. The duties of the message center chief and ability to replace in an emergency.

63. Message center corporal. (Par. 62; FM 21-25, 21-30, 30-21; TF 5-12; FS 5-1.)

- a. Qualification as *message center clerk*.
- b. Operation of a message center.
- c. General knowledge of methods of operation of all communication agencies, their capabilities and limitations.
- d. Thorough familiarity with use and operation of existing codes, ciphers, and telephone directory.
- e. Knowledge of all forms and records kept by the message center.
- f. Ability to interpret maps and air photos.

64. Message center chief. (Par. 63.)

- a. Qualification as *message center corporal*.
- b. Locate and establish message center.
- c. Army organization to include the division or similar unit of which his battery is a part.
- d. Ability to instruct all men in his section in the proper performance of their duties.
- e. Thorough knowledge of all forms and records kept by his headquarters.

GUNNERS (GUN OR HOWITZER)

65. Cannoneer (gun or howitzer). (Pars. 24, 25; FM 5-15, 5-20, 6-5, 6-130; TF 5-145, 5-146; FS 5-3, 5-10.)

- a. Nomenclature of piece and equipment of gun section.

b. Posts and duties in the service of the piece of all members of the gun squad and the chief of section.

c. Cleaning and care of matériel.

d. Handling and care of ammunition, fuzes, and primers.

e. Qualification as driver of prime mover and in the use of the winch.

f. Camouflage matériels and their use.

g. Emplacements and field fortifications.

h. Knowledge of close antitank defense.

i. Firing subcaliber and service ammunition.

66. Gunner corporal (gun or howitzer). (Pars. 65, 67.)

a. Qualification as *cannoneer*.

b. Ability to train all members of the gun squad in their posts and duties.

c. Ability to perform the duties of the *chief of section*.

67. Chief of section (gun or howitzer). (Par. 65; TM 9-300 series or ordnance maintenance TR as appropriate; FM 21-25, 25-10 (25-5); TF 5-12, 5-148, 5-149; FS 5-1, 5-2.)

a. Qualification as *gunner corporal*.

b. Knowledge of ammunition and its markings.

c. Knowledge of camouflage and field fortifications.

d. Knowledge of fire commands and their execution.

e. Knowledge of all safety precautions.

f. Ability in boresighting and servicing the recoil mechanism.

g. Advanced knowledge in map reading.

h. Ability to instruct all members of the section in their duties.

GUNNERS (AA AND AT PLATOON)

68. Gunner (37-mm AT). (Pars. 25, 31c; FM 5-15, 5-20, 6-5, 24-5, 30-40, 30-42; TM 9-1245.)

a. Nomenclature and use of the antitank gun and equipment of the gun section.

b. Duties in the service of the piece of all members of the gun squad and the chief of section.

c. Cleaning and care of matériel.

d. Handling and care of ammunition.

e. Qualification as driver of prime mover.

f. Adjustment of sight alinement by boresight.

g. Occupation, concealment, and cover of antitank gun position.

h. Qualification in prescribed firing course for antitank gunners.

i. Estimation of ranges.

j. Identification of hostile and friendly mechanized vehicles.

k. Visual signaling.

69. Gunner (AA machine gun, caliber .50). (Pars. 25, 31*b*; FM 5-15, 5-20, 6-5, 23-60, 23-65, 24-5, 30-30, 30-35, 30-40, 30-42; TM 9-226.)

a. Nomenclature and use of antiaircraft machine gun.

b. Duties of all members of the gun squad.

c. Disassembly and assembly of machine gun.

d. Identification and reduction of stoppages.

e. Cleaning and care of matériel.

f. Handling and care of ammunition.

g. Qualification as driver of prime mover.

h. Occupation and concealment of position.

i. Qualification in prescribed firing course for antiaircraft machine gunners.

j. Estimation of ranges.

k. Enemy methods of air attack.

l. Silhouette and distinctive markings of hostile and friendly aircraft and mechanized vehicles.

m. Visual signaling.

70. Squad leader (AA and AT platoon). (Pars. 68, 69; FM 25-10.)

a. Qualification as *gunner (antitank)* and *gunner (antiaircraft)*.

b. Thorough knowledge of ammunition and its markings.

c. A general knowledge of camouflage and field fortifications as applied to his weapons.

d. Conduct of the fire of the squad.

e. Knowledge of motor maintenance.

71. Chief of section (AA and AT platoon). (Par. 70; FM 6-20, 21-25, 21-30, 30-40, 30-42; TF 5-12; FS 5-1.)

a. Qualification as squad leader (*antiaircraft and antitank platoon*).

b. Thorough knowledge of the tactical employment of the section.

c. Knowledge of and ability to maintain ammunition supply.

d. Thorough knowledge in the use of maps.

e. Knowledge of enemy methods of attack.

72. Scout sergeant (AA and AT platoon). (Par. 92; FM 6-5, 21-25, 25-10, 30-40, 30-42; TF 5-12; FS 5-1, 5-2.)

a. Qualification as *instrument operator*.

b. Reconnaissance and selection of positions and routes for the platoon.

c. Advanced ability in the use of maps and photos.

73. Platoon sergeant (AA and AT platoon). (Pars. 71, 92.)

- a. Qualification as *chief of section (antiaircraft and antitank platoon)*.
- b. Expert knowledge of concealment and field fortifications as applied to his platoon.
- c. General knowledge of radio communication.
- d. Ability to supply the platoon in the field.

MECHANICS, OTHER THAN MOTOR MECHANICS

74. Mechanics (artillery and general). (FM 5-10, 6-20, 6-130, 23-series, 25-5, 25-10; TM 9-200 and 300-series; SNL; TF 1-221, 9-30, 9-31, 9-57, 6-series, as appropriate; FS 7-5, 7-6, 7-16, 7-17, 7-68, 9-4, 9-16, 9-17.)

- a. Use of ordnance and quartermaster handbooks—TM, SNL; general nomenclature.
- b. Cordage, blocks, tackles, and levers.
- c. Ammunition—marking, cleaning, storage, and packing.
- d. Blacksmithing—drawing, forging, welding, tempering, soldering.
- e. Sights, quadrants, fuze setters, fire-control instruments; tests and authorized adjustments.
- f. Guns and carriages—nomenclature, maintenance, adjustment, and repair; use of tools and accessories; cleaning and preserving materials.
- g. Carpentry—lumber, framing, joints, splices, fastenings.
- h. Estimates of matériel.
- i. Entraining and detraining matériel.
- j. Knowledge of camp and road expedients in temporary repairs to matériel.
- k. Automatic weapons and small arms; nomenclature, maintenance, adjustment, repairs.
- l. Painting of matériel and woodwork; mixing of oils and paints; care of brushes.
- m. Canvas and automobile upholstery—simple repairs.

75. Armorer. (Par. 74.)

- a. Qualification as *mechanic, artillery*.
- b. Ability to make all adjustments and repairs to small arms and field pieces authorized within the unit.

MESS

76. Cook. (TM 10-405, 10-410; AR 40-205, 30-2210; FS 8-1, 8-4, 8-5, 8-10, 8-11, 8-12.)

a. Detailed knowledge of cooking and baking, and the care, preservation, and preparation of meat, fish, fowl, and other foodstuffs.

b. Mess sanitation.

c. Handling the ration and kitchen economy.

d. Elements of nutrition and preparation of menus.

e. Serving meals properly under all conditions of service.

f. Knowledge of the field range and field cooking.

g. Messing on trains and transports.

h. Mess management and accounting.

i. Use of fireless cooker.

77. Mess sergeant. (Par. 76; TM 10-205, 10-410.)

a. Qualification as *cook*.

b. Thorough knowledge of mess management and accounting.

c. Thorough knowledge of the field ration.

d. Ability to obtain, preserve, prepare, and distribute food in the field.

e. Knowledge of the use, maintenance, and care of the field range.

MOTOR TRANSPORT

78. Chauffeur. (Par. 25; TM 10-460; TF 5-12, 6-103 to 106, 25-67, 25-75, 6-series duties, as appropriate; FS 6-9, 10-33 to 36, 10-42.)

a. Operation.—(1) Ability to drive all vehicles of the unit.

(2) Operation of his own vehicle with complete facility, safety, and judgment under all conditions of service.

(3) Knowledge of all signs and signals used in convoy, by police, and route markers.

(4) Knowledge of highway signs and traffic regulations.

(5) Ability to follow prescribed routes on military and road maps.

(6) Complete familiarity with proper operation of vehicles in tactical and administrative marches.

(7) Put on chains and change tires with minimum time and effort.

b. Care and maintenance.—(1) Nomenclature of the principal parts and accessories of his vehicle.

(2) Knowledge of his duties in cleaning, servicing, lubrication, and upkeep of his vehicle.

(3) Knowledge of purpose and value of daily inspections.

(4) Knowledge of authorized road repairs and expedients.

(5) Common engine troubles and their correction.

(6) Care and repair of tires.

(7) Knowledge of authorized loads; how to load and secure cargo.

c. Reports.—Use and preparation of trip tickets and accident reports.

d. Accidents.—Duties, if accidents occur, to include disposition of disabled vehicle.

79. Driver, car, half-track. (Par. 78; FS 7-series, as appropriate.)

a. Qualification as chauffeur.

b. Qualification in the care and operation of all weapons carried in or on his vehicle.

80. Driver, car, scout. (Par. 79; TM 11-273; TR 1210-73.)

a. Qualification as chauffeur.

b. Qualification in the care and operation of all weapons carried in or on his vehicle.

c. Ability to perform emergency operation of the radio.

81. Driver, heavy tractor. (Par. 78.)

Qualification as *chauffeur*, except *a* (7).

82. Mechanic, automobile. (Pars. 78 to 80, incl.; TM 10-510, 10-515, 10-525, 10-540, 10-560, 10-565, 10-570, 10-580, 10-585, 10-590; TF 10-166, 25-68, 25-72; FS 10-40, 10-44.)

a. Qualification as chauffeur.

b. Standard nomenclature and classification of military motor vehicles of the organization.

c. Second echelon maintenance, both scheduled and special.

d. Efficiency in locating troubles and accomplishing their remedies.

e. Preparation of all motor vehicle records, forms, and reports.

f. Practical knowledge of the duties, operations, and driver's part in maintenance and caretaking.

g. Clear understanding of the lubrication needs of each type of vehicle of the organization.

h. Accomplishing the inspections adequately and quickly.

i. Skill in use and care of tools.

j. Ability to direct and assist in accomplishing pioneer work, field expedients, and difficult operations.

k. Practical knowledge of the preparation, loading, and securing of motor vehicles in rail and water shipment.

l. Knowledge of the methods of march maintenance.

83. Mechanic, motorcycle. (Par. 78; TM 10-515; FS 10-38.)

a. Qualification as chauffeur.

b. Qualified in motorcycle maintenance.

84. Welder. (Par. 82; TM 10-440; TF 10-165; FS 10-41.)

a. Qualification as mechanic (automobile).

b. Care and operation of welding equipment.

- c. Use of fluxes.
- d. Use of welding rod.
- e. Preparation of metals for welding.
- f. Cutting and minor welding operations.

85. Technician, automotive. (Par. 82; TM 10-550; FS 10-44.)

- a. Qualification as *mechanic, automobile*.
- b. Qualification as a fuel, carburetion, and ignition specialist.

86. Dispatcher (battalion). (FM 6-5, 6-130, 25-10; T/O; FS 10-43.)

a. Knowledge of the number of each type of vehicle in each organization and the present status of each vehicle.

b. Control of the movement of vehicles within the battalion so that he can give an immediate report at any time as to how many vehicles are immediately available.

c. Coordination of the dispatching of vehicles within the battalion so as to permit the fulfillment of both tactical and maintenance requirements.

87. Supply corporal (motors). (FM 25-10; TM 10-510, 10-515; FS 10-43.)

a. Thorough knowledge in the nomenclature of all tools, parts, assemblies, accessories, fuels, lubricants, and cleaning and preserving materials used in his unit.

b. Ability to requisition, draw, and issue motor supplies, and keep all records pertaining to such transactions.

c. Knowledge of proper care and storing of supplies.

d. Knowledge of nomenclature of all types of vehicles in his unit.

e. Ability to estimate the quantities of expendable items used for a period and the time necessary for such replacement.

f. Knowledge of proper marking of vehicles and tools.

g. Knowledge of procedure, and ability to prepare all papers involved, when motor vehicle property wears out or is lost, damaged, or destroyed.

88. Corporal, supply, gasoline. (FM 25-10; TM 10-550; FS 10-44.)

a. Methods of refueling.

b. Care and handling of hand and power gas pumps.

c. Safety precautions.

d. Records of receipt and issue of fuel, oil, and antifreeze preparations.

89. Truckmaster (sergeant). (Pars. 78, 86; FM 6-130, 21-25, 25-10; TF 5-12; FS 5-1, 5-2.)

a. Qualification as *chauffeur* and *dispatcher*.

- b. Knowledge of maps and map reading.
- c. Ability to train and direct the activities of his section.
- 90. Motor sergeant (battery).** (Par. 82; TM 10-545, 10-550; FS 10-44.)
 - a. Qualification as *mechanic, automobile*.
 - b. Ability to direct and supervise the work of the mechanics in motor maintenance.
 - c. Ability to determine the condition of all vehicles and to select those needing adjustment and repairs.
 - d. Ability to supervise the records of all adjustments, fuel, and supplies.
 - e. Familiarity with duties of battery motor officer and ability to assist him in them.
- 91. Motor sergeant (battalion and regiment).** (Par. 90.)
 - a. Qualification as *motor sergeant (battery)* and *supply corporal (motors)*.
 - b. Ability to direct and supervise second echelon motor maintenance.
 - c. Ability to supervise the painting and stenciling of vehicles.
 - d. Ability to supply batteries with fuel and parts under service conditions.

OPERATIONS, INSTRUMENTS

- 92. Instrument operator.** (Par. 16; TM 6-200; FM 6-20, 6-40, 21-25; TF 5-12; FS 5-1.)
 - a. Care, use, and adjustment of field glasses, prismatic compass, aiming circle, range finder, and battery commander's telescope.
 - b. Measuring angles and computing deflections, deflection differences, and angles of site.
 - c. Familiarity with fire commands.
 - d. Laying a battery with aiming circle.
 - e. Occupation, concealment, and cover of observation posts.
 - f. Ability to assist in survey operations.
- 93. Instrument corporal.** (Par. 92; FS 5-2.)
 - a. Qualification as *instrument operator*.
 - b. Ability in map reading and survey operations, to include—
 - (1) Locating point on map.
 - (2) Plotting of point.
 - (3) Finding coordinate of a point on a map and on the ground.
 - (4) Locating target on map.
 - (5) Computing a weather correction diagram.

(6) Duties of computer in fire direction center.

(7) Use of air photos.

c. A thorough knowledge of fire commands.

d. Recording fire commands and adjusted data.

e. General knowledge of communication.

94. Instrument sergeant. (Par. 93; FM 21-26, 21-30, 24-5, 25-10 (25-5); TM 6-215; TF 6-19; FS 6-1 to 7; 6-9.)

a. Qualification as *instrument corporal*.

b. Posts and duties of all members of the battery detail, and the equipment each member is responsible for.

c. A thorough knowledge in the use and adjustment of all instruments.

d. Communications of a battery and how to use them.

e. A thorough knowledge of fire commands.

f. A thorough knowledge of map reading and battery survey.

g. Familiarity with and ability to use a range table.

h. Ability to compute all data, and factors.

i. Ability to conduct fire using ground-observation methods.

j. General familiarity with all transport in use by the detail.

OPERATIONS, INTELLIGENCE

95. Intelligence sergeant. (Pars. 55, 92; FM 5-20, 6-120, 6-130, 21-35, 21-45, 24-5, 25-10, 30-5, 30-10, 30-21; TM 6-210, 6-230; DFC.)

a. Qualification as *telephone operator* and *instrument operator*.

b. Scouting and patrolling.

c. Route making.

d. Camouflage.

e. Visual signaling.

f. Air-ground liaison, Morse, and division field codes.

g. Panoramic sketching.

h. Ability to locate, set up, conceal, and operate an intelligence observation post.

i. Collect and collate intelligence with particular attention to—

(1) Type of enemy matériel likely to occupy a given position.

(2) Amount, kinds, and direction of artillery fire received.

j. Knowledge of maps and map substitutes to include stereoscopic interpretation.

k. Knowledge of orientation and survey.

l. Proficiency in making overlays.

m. General knowledge of the functions of the observation battalion.

n. Knowledge of the installation and maintenance of communication nets employed by his unit.

o. Ability to direct the activities of his section.

p. Knowledge of the duties of the intelligence officer.

96. Survey. (Pars. 92, 103; FS 6-3.)

a. Qualification as *instrument operator and tapeman*.

b. Care and use of survey equipment.

c. Survey operations: Traverse, resection, intersection, computation of angles and distances, note keeping.

d. Map and photo reading (including restitution).

e. Firing charts and plotting of data.

f. Computation of data from firing charts (maps, photos) and reproduction of overlays.

97. Draftsman, sergeant. (FM 6-40, 21-25, 21-26, 21-30, 30-20; TM 1-220, 5-230; TF 5-12, FS 5-1, 5-2.)

a. Skilled in the use of maps and map substitutes.

b. Cutting and fitting of mosaics.

c. Restitution.

d. Preparation of overlays.

OPERATIONS, FIRE DIRECTION

98. HCO (horizontal control operator). (FM 6-40, 21-25, 21-30; TF 5-12; FS 5-1, 5-2.)

a. Map and air photo reading, including restitution.

b. Drafting; use of following equipment: Plotting scale, straight-edge, coordinate square, protractor, range deflection fan.

c. Preparation and use of firing chart, plotting points by precision methods and by coordinate square. Plotting and marking base line extensions. Plotting of centers of impact. Plotting situation, using conventional signs. Restitution by inspection and by exact methods. Reading corrections from correction scale. Measurement of ranges and base deflections shifts with range deflection fan. Replotting targets from adjusted data.

99. VCO (vertical control operator). (Par. 98; FM 21-26; TF 6-111.)

a. Qualification as *horizontal control operator*.

b. Determination of altitudes from distance and angle site.

c. Determination of angles of site from altitudes and distance.

d. Use of Mannheim type slide rule for multiplication and division, and combined multiplication and division.

e. Application of complementary angle of site.

f. Use of stereoscope for study of relief.

100. Computer. (Pars. 98, 99; TM 6-215.)

- a. Qualification as horizontal control operator and vertical control operator.*
- b. Knowledge of sequence and meaning of fire commands.*
- c. Ability to convert map data furnished by horizontal control and vertical control operators into fire commands.*
- d. Ability to use graphical firing table slide rule.*
- e. Conversion of sensings into fire commands.*
- f. Computation and application of meteorological corrections.*
- g. Determination and application of registration corrections.*

OPERATIONS, SURVEY PARTY (FIRE DIRECTION GROUP)

101. Axeman. (FM 6-40, 21-25; TM 6-200, 6-220.)

- a. Care and use of all survey equipment.*
- b. Map and photo reading including restitution.*
- c. Ability to act as rodman or tapeman in running traverses.*
- d. Clearing of obstacles for traverses and for sighting.*

102. Rodman. (Par. 101.)

- a. Qualification as axeman.*
- b. Qualified in keeping and interpreting notes.*

103. Tapeman. (Par. 101.)

Qualification as *rodman*.

104. Recorder. (Par. 101; TM 5-230.)

- a. Qualification as tapeman.*
- b. Survey operations: Resection, intersection, computations (including the solution of the triangle by trigonometry).*
- c. Drafting insofar as it involves field artillery plotting equipment.*

105. Computer. (Par. 104.)

Qualification as *recorder*.

106. Transitman. (Pars. 104, 107.)

- a. Qualification as computer.*
- b. Ability to perform duties of chief of party.*

107. Chief of party. (FM 6-20, 6-40, 21-25, 21-26, 21-30; TM 5-230, 6-200, 6-215; TF 5-12, 6-111; FS 5-1, 5-2.)

- a. Qualification as transitman and battery computer (par. 100).*
- b. Ability to perform the duties of the reconnaissance officer.*

OPERATIONS, METEOROLOGY

108. Meteorologist. (Par. 135; TM 5-235.)

Qualification as *meteorologist (senior)* meteorological section, observation battalion (par. 135).

109. Metro sergeant. (Par. 108; FM 6-5, 6-40, 21-25, 24-5; T/O.)

- a.* Qualification as *meteorologist*.
- b.* Army organization to include the division or similar unit of which his battery is a part.
- c.* Read and interpret maps and air photos.
- d.* Communication systems within the division or similar unit.
- e.* Theory and practice of metro observations, to include all observations and calculations necessary to the formulation of the meteorological message.
- f.* Ability to organize the work of his section and instruct individual members in their duties.

OPERATIONS, SCOUTS

110. Scout corporal (battery). (FM 6-20, 6-40, 21-25, 21-100, 24-5; TM 6-220, 6-230; TF 6-111, 6-112; FS 11-1.)

- a.* Qualification as *visual signalman* and *messenger*.
- b.* Ability to set up and operate all fire-control instruments and assist in survey operations.

111. Liaison. (FM 6-20, 6-40, 21-25, 21-35, 30-5; TM 6-210, 6-230; TF 5-12; FS 5-1, 5-2.)

- a.* Special training in map and photo reading, compass, and orientation.
- b.* Ground observation of fire using air-ground methods
- c.* Methods of transmitting information.
- d.* Purposes of liaison and duties of other members of the section
- e.* Use of air-ground liaison code.
- f.* Simple sketching.
- g.* Reconnaissance by day and by night.
- h.* Identification and description of hostile installations and forces.

112. Liaison corporal. (Pars. 78, 111.)

- a.* Qualification as listed in paragraph 111.
- b.* Ability to perform the duties of *liaison sergeant*.

113. Liaison sergeant. (Pars. 78, 111.)

- a.* Qualification as *chauffeur* and *liaison corporal*.
- b.* Ability to direct the activities of the section.
- c.* Ability to perform the duties of the liaison officer.

SUPPLY

114. Supply clerk. (AR's; SNL's; T/BA's; TM 12-250.)

- a.* Typing.
- b.* Rations—drawing and issue.

- c. Ammunition—drawing and issue.
- d. Clothing—drawing and issue.
- e. Equipment—drawing and issue.
- f. Regulations and forms relating to supply.
- g. General knowledge of all classes of property.

115. Supply corporal (battalion). (AR's; SNL's; T/BA's; TM 12-250.)

- a. Expert knowledge of all supply forms.
- b. A thorough knowledge of stock records.
- c. Property accountability and responsibility, and transfer of property accountability.
- d. Requisitioning and receipt and issue of property and rations.
- e. A thorough knowledge of shipping tickets and transportation records.
- f. Sizes of clothing and shoes, fitting, issue, and prices of clothing.
- g. Proper action upon lost, destroyed, damaged, or worn-out property; surveys and statement of charges.
- h. A thorough knowledge of accounting and issue of rations, and ammunition.

i. Care of equipment and arms in storage.

j. Use of typewriter.

116. Supply sergeant (battery). (AR's; SNL's; T/BA's; TM 12-250.)

- a. Thorough knowledge of battery tables of allowances.
- b. Knowledge of requisitioning, drawing, storing, and issuing of all clothing, equipment, and supplies.
- c. Knowledge of proper marking of all clothing and equipment.
- d. Ability to prepare all forms and records pertaining to battery supply.

e. Nomenclature of all equipment in battery.

f. Procedure to be followed regarding worn-out, damaged, destroyed, lost, and abandoned property, and property left by deserters and deceased.

g. Procedure to be taken on property upon the confinement, transfer, discharge, or retirement of a soldier.

117. Supply sergeant (battalion). (AR's; SNL's; T/BA's; FM 25-10; TM 10-510, 10-515, 12-250; FS 10-43.)

a. Qualification as *supply sergeant (battery)*, *supply corporal (battalion)*, and *supply corporal (motors)*.

b. Thorough knowledge of all tables of allowances for the battalion, and the methods by which all supplies and equipment are received.

c. Ability to anticipate the needs of the battalion and provide the means for obtaining all supplies and rations under all conditions of service.

d. Knowledge of duties of supply officer and ability to assist him.

MUSICIANS

118. Musicians. (FM 6-5, 8-35, 21-10, 21-15, 22-5, 28-5; TM 20-250.)

a. Know all scales, have an understanding of phrasing and a good sense of intonation, and be able to read on sight a medium grade march.

b. Ability to play while marching.

a. Advanced knowledge of first aid and the transportation of wounded by issue and improvised litters over difficult terrain.

OBSERVATION BATTALIONS, SOUND PLOTTING

119. Computer (junior). (FM 6-120; TM 5-235, 5-236.)

a. General knowledge of the installation used in sound ranging, and the purpose of each of its components.

b. Know and understand the definitions of paragraph 25, FM 6-120.

c. Understand the theory of the propagation of sound.

d. Know the velocity of sound under standard conditions, and what conditions are taken to be standard.

e. Know how the velocity of sound is influenced by wind and temperature.

f. Proficiency in the use of the wind corrector and temperature and asymptote correction charts.

g. Ability to add and subtract algebraically with speed and accuracy.

h. Ability to use the calculating machine to obtain averages.

i. Ability to multiply and divide by the use of logarithms.

j. Ability to set up the mechanical sound-ranging plotting board for use with any standard sound base.

120. Computer (senior). (FM 6-120; TM 5-235, 5-236.)

a. Qualification as *computer (junior)*.

b. Ability to recognize immediately any gross errors in film readings or in corrections.

c. Proficiency in the use of computation Forms Nos. 1 and 2, paragraph 13, FM 6-120.

d. Ability to calculate the coordinates of all microphones and mid-points of a sound base, when given the size and type of base, azimuth of the long chord, and coordinates of one microphone.

e. Ability to calculate the azimuth of each sub-base of a sound base, when given the coordinates of the microphones, or when given the size and type of base and azimuth of the long chord.

121. Computer, corporal. (FM 6-120; TM 5-235, 5-236.)

a. Qualification as *computer (senior)*.

b. Theories of hyperbolic and asymptotic plotting.

c. Equations for calculating wind, temperature, and asymptote corrections.

d. General pattern on the film for a sound record from a sound source in any given direction from a regular base.

e. Ability to read a sound film with speed and accuracy.

f. Characteristic appearance on sound film of gun burst and shell waves, and be proficient in matériel discernment.

122. Draftsman, sergeant. (Par. 121; TM 5-230, 5-235, 5-236, 3-240; TR 1236-1.)

a. Qualification as *computer, corporal*.

b. Ability to lay out a grid on the plotting board.

c. Ability to plot and to read plots quickly and accurately, using either the standard or improvised plotting board.

d. Ability to lay out a grid and plot, and to instruct his subordinates how to apply the corrections, when plotting to a scale which is a multiple or submultiple of the standard 1: 20,000.

e. Ability to plot records with strings missing, and to instruct his subordinates how to apply the corrections.

f. Ability to classify plots as to type, as in paragraph 34e, FM 6-120, and know the probable error for each type of plot.

g. General understanding of the method used by the meteorological section in weighing the velocity and direction of the wind.

123. Draftsman, staff sergeant. (Par. 122; FM 6-20, 6-40, 21-25, 21-30; TM 4-225, 6-200.)

a. Qualification as *draftsman, sergeant*.

b. Demonstration of his ability to supervise and coordinate the work of the plotting section.

c. Ability to select a suitable position in the field for the sound central, and direct its occupation.

d. Ability to lay out a sound base on the map, and determine the data necessary for proceeding with the calculation of the coordinates of the microphones.

e. Ability to construct an improvised plotting board for either a regular or irregular base, and to lay out the necessary time scales.

OBSERVATION BATTALIONS, SURVEY

124. Rodman. (FM 6-120; TM 5-235, 6-200.)

- a.* How to hold a rod.
- b.* Rod signals.
- c.* How to set on a point.
- d.* How to pick turning points.
- e.* How to mark turning points clearly.
- f.* How to keep level notes.
- g.* How to read all types of level rods.
- h.* Theory of surveying.
- i.* How to judge terrain.

125. Tapeman. (FM 6-120; TM 5-235, 6-200.)

- a.* Qualification as *rodman*.
- b.* How to care for a tape.
- c.* How to use a plumb bob.
- d.* How to make corrections for sag, pull, etc.
- e.* What is a correct tension on a tape.
- f.* How to keep on line.
- g.* How to pace.
- h.* Importance of work.
- i.* How to read all kinds of tapes.
- j.* Taping signals.
- k.* How to keep taping notes.

126. Level corporal. (FM 6-120; TM 5-235, 5-236, 6-200.)

- a.* Qualification as *tapeman*.
- b.* The care and use of a level.
- c.* Adjustments of a level.
- d.* How to run levels with a transit.
- e.* How to read stadia.
- f.* Theory of leveling.

127. Transit sergeant. (Par. 126; TM 4-225.)

- a.* Qualification as *level corporal*.
- b.* The care and use of a transit.
- c.* Adjustments of a transit.
- d.* How to keep transit notes.
- e.* How to compute.
- f.* How to take observations on the sun and Polaris.
- g.* How to measure horizontal and vertical angles.

OBSERVATION BATTALIONS, FLASH OBSERVERS

128. Observer, flash. (Par. 9; FM 6-20, 6-120, TM 5-235.)

- a. Installation of observation post.
- b. Tests of telephone.
- c. Splicing wire.
- d. How to use tape and rod.
- e. Ability to describe enemy activities.
- f. Recording data pertaining to flash observing.
- g. Operation of the outpost capacitor unit.

129. Observer, corporal. (Par. 128; FM 21-35, 21-45; TM 6-200.)

- a. Qualification as *observer, flash*.
- b. Ability to read coordinates and to estimate ranges.
- c. Panoramic sketching.
- d. Scouting and patrolling.
- e. Qualification as a computer.
- f. Operate a transit.
- g. Operate a level.
- h. Ability to describe all enemy activities observed.
- i. Qualification as an instructor in the installation and operation of flash observation post.
- j. Ability to orient on Polaris.
- k. Care and use of an azimuth instrument.

130. Chief observer. (Par. 129; FM 6-40, 21-25; TM 5-236.)

- a. Care and nomenclature of instruments.
- b. Care and nomenclature of switchboard.
- c. Care and use of telephones.
- d. Care and use of plotting board.
- e. Ability to grid plotting board.
- f. Qualification as surveyor.
- g. Ability to set up complete flash installation.
- h. Ability to compute high burst adjustment.
- i. Ability to locate flash observation posts by use of map or aerial photo.
- j. Duties of each man in flash and topographic section.
- k. Ability to instruct all members of the flash section on performance of duties.
- l. Responsibility for the installation and operation of all flash observation posts.

OBSERVATION BATTALIONS, TOPOGRAPHERS—GENERAL

131. Topographer surveyor (staff sergeant). (FM 6-20, 6-120, 21-25, 21-26, 21-30; TM 4-225, 5-230, 5-235, 5-236, 6-200; TF 5-12; FS 5-1, 5-2.)

- a.* Arithmetic, algebra, and plane trigonometry.
- b.* Ability to use logarithms, the slide rule, and commercial type calculating machines.
- c.* Solution of triangles by trigonometric methods.
- d.* Ability to calculate and adjust azimuths.
- e.* Preparation and interpretation of standard forms used in keeping field notes.
- f.* Ability to conduct field surveys if necessary—to include leveling, traversing, triangulation, use of plane table, and base line measurements with application of corrections.
- g.* Basic drafting to include scale drawings from field notes.
- h.* Computations for high burst adjustment.
- i.* Computation and adjustment of rectangular coordinates.
- j.* Computation of coordinates from azimuth and distance.
- k.* Triangle computation by coordinates method.
- l.* Adjustment of a central point figure.
- m.* Theory of computing and staking out curves.
- n.* Various methods of intersection and resection.
- o.* Reduction of stadia notes.
- p.* General functions of sound and flash units, and a thorough knowledge relating to topographer surveyor's section.
- q.* Grid system used in military mapping with the various symbols required.
- r.* Ability to read aerial photographs.
- s.* In addition to the above, he should have a thorough knowledge of the requirements called for in the lesser ratings of this category.

132. Topographer surveyor (technical sergeant). (Par. 131.)

- a.* Qualification as *topographer surveyor (staff sergeant)*.
- b.* Knowledge of the degree of accuracy required in field surveys and respective computations under given conditions.
- c.* Working knowledge of the theory of geodetic surveys.
- d.* Working knowledge of geodetic computations.
- e.* Detailed knowledge of topographical drafting and aerial photo-reading.
- f.* Ability to make solar and Polaris observations, to include methods of determining time by solar and sidereal systems.
- g.* Detailed functions of all sound and flash units.

133. Topographical draftsman (master sergeant). (Par. 131.)

- a. Qualification as topographer surveyor (technical sergeant).*
- b. Drafting procedure, both mechanical and topographical.*
- c. Use and care of all drafting instruments.*
- d. Standard forms for keeping field notes and ability to interpret same.*
- e. Detailed functions of sound and flash units.*
- f. Military and geodetic mapping with thorough familiarity with methods and symbols used.*
- g. Details of survey methods used in triangulation resections, traversing, differential leveling, and the use of stadia and plane table.*
- h. Making scale drawings from field sketches.*
- i. Reading, calibration, and gridding air photographs.*
- j. Converting air photographs to a scaled map.*
- k. Making graphs, charts, and diagrams.*
- l. Making fire-control charts.*
- m. Arithmetic, algebra, and plane and spherical trigonometry.*
- n. Details of command post functions and ability to coordinate data received from S-2 and S-3.*

OBSERVATION BATTALIONS, METEOROLOGICAL SECTION

134. Meteorologist (junior). (FM 6-120; TM 3-240; TR 1236-1.)

- a. Knowledge of weather elements reckoned with in a meteorological message.*
- b. Knowledge of the various kinds of military meteorological messages.*
- c. Duties of a meteorological observer.*
- d. General procedure for determining speed and direction of wind beyond the earth's surface.*
- e. Filling the meteorological balloon.*
- f. How weather soundings are made at night.*

135. Meteorologist (senior). (FM 6-120; TM 3-240; TR 1236-1.)

- a. Qualification as meteorologist (junior).*
- b. Operation and care of the theodolite.*
- c. Establishing the theodolite station and azimuth.*
- d. "Weighing off" the meteorological balloon.*
- e. The elevation angle and azimuth.*
- f. Three ways of orienting the theodolite.*
- g. Use of the barometer.*
- h. Use of the psychrometer.*

136. Meteorological corporal. (FM 6-120; TM 3-240; TR 1236-1.)

- a. Qualification as *meteorologist (senior)*.
- b. Care, use, and adjustment of the theodolite.
- c. Ability to track the released balloon aloft under difficult visibility and rapidly changing wind direction.
- d. Choosing most visible color of balloon after analysis of sky and cloud formation.
- e. Read elevation and azimuth scales of theodolite correctly and quickly.
- f. Knowledge of time intervals for readings on balloon.
- g. Ability to make all *surface* weather determinations.
- h. Computation of ballistic air density for all maximum ordinates, corrected for humidity.

137. Meteorologist (sergeant). (FM 6-120; TM 3-240; TR 1236-1.)

- a. Qualification as *meteorological corporal*.
- b. Ability to perform quickly all steps necessary to the graphical determination of a ballistic wind by use of the plotting board ML-57.
- c. Knowledge of the application and reason for use of wind-weighting factors as applied to true wind values.
- d. Familiarity with the process of true wind and directional plotting by use of plotting board ML-55.
- e. Know how to apply zone effects to a meteorological message taken for use in sound ranging.
- f. Know how to make necessary weather determinations for use in sound ranging.

138. Meteorologist (technical sergeant). (FM 6-120; TM 3-240; TR 1236-1.)

- a. Qualification as *meteorologist (sergeant)*.
- b. Ability to make all necessary determinations for a military meteorological message for aviation bombing, low- and high-angle artillery fire.
- c. Ability to encode quickly the results of his weather determination.
- d. Thorough familiarity with proper channels for procurement of supplies.
- e. Ability to instruct the members of his section in their duties.
- f. Ability to apply new tops to both plotting boards ML-55 and ML-57.
- g. Ability to make an *approximate* weather determination by improvised means.

OBSERVATION BATTALIONS, COMMUNICATION PERSONNEL—GENERAL

139. Communication chief, technical sergeant; communication chief, staff sergeant; signal sergeant; signal corporal. (FM 6-120, 24-5.)

In addition to their normal signal communication functions, communication personnel should be qualified in the following:

- a.* The normal field artillery observation battalion wire net.
- b.* The purpose of and use of capacitor units and outpost sets.
- c.* The necessary alterations which must be made on the standard EE-8A field telephone to make it suitable for use in line testing on sound and flash outpost lines.
- d.* The necessary alteration which must be made on the EE-65 test set to adapt it to use in testing sound and flash lines and the testing procedure to be used.
- e.* Procedure for installing lightning arrestors and microphones, the method of checking the microphone installation both in cooperation with the oscillograph operator and independently of him.
- f.* Familiarity with the operation of the flash switchboard.

OBSERVATION BATTALIONS, SOUND RECORDING SECTION

140. Developer (junior). (FM 6-120, 24-5; TM 1-219.)

- a.* Working knowledge of photography.
- b.* Elementary knowledge of communication. (Over-all test of telephone, splices, and connections.)
- c.* General knowledge of duties of all members of the sound operation section.
- d.* Adjustment, maintenance, and operation of oscillograph camera.
- e.* Knowledge of the BK-9 relay units so far as they affect camera operation.

141. Developer (senior). (FM 6-120, 24-5; TM 1-219.)

- a.* Qualification as *developer (junior)*.
- b.* Knowledge of the chemical action of the various compounds used in developing.
- c.* Specialized knowledge of the coordinated action of the BK-9 relay unit and the oscillograph camera action.
- d.* Thorough knowledge of maintenance, operation, and care of the oscillograph camera.
- e.* Effects of temperature on photographic processes and measures to be taken to compensate for deviations from normal conditions.

142. Observer, sound. (Par. 55; FM 6-120, 21-25, 21-45, 24-5.)

a. Installation, operation, and maintenance of outpost equipment.

b. General knowledge of the coordinate functions of the outpost circuit and the BK-9 relay unit.

c. Thorough knowledge of telephonic communication.

d. Thorough knowledge of scouting and patrolling including map reading and the use of compass.

143. Observer, corporal, sound. (Par. 55; FM 6-120, 21-25, 21-45, 24-5.)

Qualification as *observer, sound*.

144. Storage battery operator. (Par. 140; FM 21-25; TR 1190-5; TF 25-75.)

a. Qualification as *developer (senior)* and *observer, sound* (less d).

b. Care and maintenance of Edison nickel-iron cells.

c. Care and maintenance of lead-acid storage cells.

d. Care and maintenance of charging equipment.

145. Electrical mechanic. (Par. 55; FM 6-120, 21-45; TM 1-219, 11-333; TR 1190-5; TF 25-75.)

a. Qualification as *developer (senior)* and *observer, sound* (less d).

b. Thorough knowledge of outpost equipment, its operation, maintenance, and repair, and the circuits involved.

c. Thorough knowledge of switchboard circuits, operation, and maintenance.

d. Thorough knowledge of control panel circuits, their operation, maintenance, and repair.

e. Thorough knowledge of oscillograph circuits, operation, and maintenance, including camera operation.

f. Thorough knowledge of microphone circuits, operation, maintenance, and repair.

g. Knowledge of storage batteries, generators, and methods of charging.

h. Thorough knowledge of the theory of electricity to include theory of thermionic tubes, audio-frequency amplification, and electric damping and filters.

i. Thorough competency with hand tools.

146. Recorder sergeant. (Par. 55; FM 2-120, 21-25, 24-5; TM 1-219; TR 1190-5; TF 25-75.)

a. Qualification as *developer (senior)*, *observer corporal, sound, storage battery operator* and *electrical mechanic*.

b. Elementary knowledge of principles of sound plotting.

c. Proficiency in interpreting oscillograms.

147. Technical sergeant, sound. (Par. 146.)

- a. Qualification as recorder sergeant.*
- b. Thorough understanding of the principles of sound plotting.*
- c. Expertness in interpretation of sound records or oscillograms.*

OBSERVATION BATTALIONS, FLASH PLOTTING

148. Computer (flash plotting). (FM 6-120; TM 5-236.)

- a. Be thoroughly familiar with assembly, disassembly, and packing operation.*
- b. Have a working knowledge of algebra, plane geometry, and trigonometry including logarithms.*
- c. Have a natural inclination and ability to handle figures with absolute accuracy and speed.*

149. Computer corporal (flash plotting). (FM 6-120, 21-25; TM 5-236.)

- a. Qualification as computer (flash plotting).*
- b. Ability to make neat and accurate records of azimuth readings as rapidly as they can be repeated by the flash switchboard operator.*
- c. Ability to relieve the draftsman sergeant on the plotting board and draw the rays and read the coordinates of the plot.*

150. Draftsman sergeant (flash plotting). (FM 6-120, 21-25, 24-5; TM 5-236.)

- a. Qualification as computer corporal (flash plotting).*
- b. Ability to plot neatly and accurately any point from its map coordinates on either a gridded sheet or the plotting board.*
- c. Ability to read accurately the coordinates of a point with a scale, and to read accurately the azimuths with a protractor.*
- d. In the absence of a plotting board to be able to plot a flash-ranging location or a flash-ranging adjustment using gridded sheets, plotting scales, and a protractor.*
- e. Ability to relieve the switchboard operator for short periods.*

151. Flash switchboard sergeant. (Pars. 128, 148.)

- a. Qualification as computer (flash plotting) and observer, flash.*
- b. Thorough familiarity with procedure both at the command post and the observation post.*
- c. Ability to make rapidly an accurate and neat record.*
- d. Thorough understanding of the circuits, installation, testing operation, maintenance, and care of the switchboard, and how to make adjustments and repairs of same.*
- e. Know how the observers should test their outpost sets, and know how to operate outpost sets and telephones.*

OBSERVATION BATTALIONS, SURVEYOR

152. Computer (junior). (FM 6-120, 6-40, 21-25, 21-26; TM 5-235, 5-236; TF 5-12; FS 5-1, 5-2.)

a. Surveying.—(1) Basis of military grid system.

(2) General and fundamental map reading.

(3) Establishment and use of orienting lines.

(4) Running traverses.

(5) Knowledge of triangulation.

(6) Knowledge of three survey methods of laying out a sound arc.

(7) Keeping and using survey field notes, including level notes.

b. Algebra.—(1) Principles of transposition of equations.

(2) Algebraic addition and subtraction.

(3) Definitions, terminology, and use of logarithms.

c. Plane geometry.—(1) Definitions for and description of plane geometrical figures.

(2) Fundamental geometrical theorems.

d. Trigonometry.—(1) Understanding of ratio and proportion.

(2) Ability to use the trigonometric functions in the solution of the right triangle.

(3) Ability to use the sine law in the solution of an oblique triangle.

e. Computations.—(1) Ability to obtain azimuth and distance from two sets of coordinates.

(2) Ability to take the azimuth and the turned angle and obtain a new azimuth.

(3) Ability to compute the coordinates of a new point, knowing the azimuth and distance from a known point given.

(4) Ability to compute the elevation of an unknown point, knowing the distance and the angle of elevation from a known point.

(5) Ability to compute the coordinates of a point by triangulation.

(6) Ability to compute a combined triangulation and traverse.

(7) Ability to convert mils to degrees and degrees to mils.

153. Computer (senior). (FM 6-120, 6-40, 21-25, 21-26; TM 5-235, 5-236; TF 5-12; FS 5-1, 5-2.)

a. Qualification as computer (junior).

b. Survey.—(1) Ability to operate survey instruments.

(2) Thorough understanding of the closing of the horizon and the adjustment of the angles of a triangle.

(3) Ability to adjust a traverse.

c. Plane trigonometry.—(1) Ability to solve oblique triangles using the law of cosines and the law of tangents.

(2) Trigonometric identities necessary for solving three-point resections.

d. Computations.—(1) Ability to compute three-point resections.

(2) Ability to convert latitude and longitude into grid coordinates, and grid coordinates into latitude and longitude.

154. Computer corporal. (Par. 153.)

a. Qualification as computer (senior).

b. Ability to instruct in the following subjects:

(1) Basic survey operations and practice.

(2) Fundamental algebra.

(3) Fundamental plane geometry.

(4) Fundamental plane trigonometry.

(5) Military map reading.

(6) All forms of survey computing.

SECTION IV

BATTERY AND BATTALION

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155. Gun (howitzer) battery.—The trained gun (howitzer) battery is able to function efficiently at all times as a tactical, technical, and administrative unit operating either in the role of a separate battery or as part of a battalion. It is highly trained in mobility, tactical and technical functions, and administration, supply, and motor maintenance. The detailed requirements under these headings are as follows:

a. Mobility.—(1) Reconnoiter routes rapidly.

(2) Follow routes with or without the use of maps or map substitutes.

(3) Mark routes rapidly.

(4) March long distances at high rates of speed.

(5) Cross difficult terrain.

(6) Negotiate obstacles and make roadside repairs to motors.

(7) Maintain proper march discipline.

b. Tactical and technical functions.—(1) As far as practicable with the means available, provide its own security and defense against shell fire, air, ground, and gas attacks, in bivouac, on the march, and in position.

(2) Conceal itself from enemy observation by natural and artificial means in bivouac and in position.

(3) Reconnoiter, occupy, and organize positions expeditiously.

(4) Establish and maintain communication.

(5) Establish and maintain effective observation.

(6) Execute survey operations including the location of the firing battery, observation posts, and other points desired.

(7) Prepare firing data rapidly.

(8) Deliver fire with minimum delay, either as a separate battery or as part of a battalion.

(9) Displace without time loss, in the delivery of fire, except that needed to move the firing battery.

(10) Construct standard types of field fortifications, emplacements, and protective shelters.

(11) Distribute, handle, store, and protect ammunition with facility and care.

c. Administration, supply, and maintenance.—(1) Maintain a properly organized headquarters section.

(2) Insure an adequate and satisfactory mess.

(3) Select and occupy suitable camp and bivouac sites promptly.

(4) Provide reliefs in all positions so as to function in continuous operations.

(5) Maintain at least one trained replacement for each specialist in the battery.

(6) Provide prompt first aid and evacuation of casualties.

(7) Insure proper care, use, and maintenance of its matériel, motor vehicles, and other equipment.

(8) Insure the timely issue of its equipment, rations, fuel, and other supplies.

(9) Maintain the rear echelon so as to handle effectively all matters of administration, messing, supply, and maintenance.

156. Service and ammunition battery.—The trained service and ammunition battery is able to function efficiently at all times as a tactical, technical, supply, and administrative unit operating as part of a battalion. It is highly trained in mobility, supply and motor maintenance, ammunition supply, and administration, supply and maintenance. The detailed requirements under these headings are as follows:

a. Mobility.—(1) Reconnoiter routes rapidly.

(2) Follow routes with or without the use of maps or map substitutes.

(3) Mark routes rapidly.

(4) March long distances at high rates of speed.

(5) Cross difficult terrain.

(6) Negotiate obstacles and make roadside repairs to motors.

(7) Maintain proper march discipline.

b. Supply and motor maintenance (battalion).—(1) Procure, distribute, and account for all arms, rations, clothing, equipment, fuel, and other supplies for the battalion.

(2) Supervise all motor-vehicle maintenance in the battalion.

(3) Install and operate maintenance and supply facilities for motor vehicles of the battalion.

(4) Repair, maintain, and replace motor vehicles, assemblies and parts.

(5) Perform emergency repairs to vehicles which fall out on the march.

(6) Coordinate and supervise higher echelon repairs to battalion motor vehicles.

(7) Supervise, generally, motor-vehicle operation and maintenance records of the battalion.

(8) Account for allotted funds expended upon each motor vehicle in the battalion.

(9) Collect, classify, and dispose of salvaged equipment and supplies within the battalion.

c. Ammunition supply (battalion).—(1) Procure and distribute all ammunition required by the battalion.

(2) Store and protect all ammunition not distributed to the batteries.

(3) Account for all ammunition drawn, issued, stored, and expended by type of projectile, fuze, charge, lot manufacturer, etc.

(4) Salvage ammunition left at the battery positions.

d. Administration, supply, and maintenance.—(1) Maintain a properly organized headquarters section.

(2) Insure an adequate and satisfactory mess.

(3) Select and occupy suitable camp and bivouac sites promptly.

(4) Provide reliefs in all positions so as to function in continuous operations.

(5) Maintain at least one trained replacement for each specialist in the battery.

(6) Provide prompt first aid and evacuation of casualties.

(7) Insure proper use, care, and maintenance of its matériel, motor vehicles, and other equipment.

(8) Insure the timely issue of its equipment, rations, fuel, and other supplies.

(9) Maintain the rear echelon to handle effectively all matters of administration, messing, supply, and maintenance.

157. Headquarters battery.—The trained headquarters battery is able to function efficiently at all times as a tactical, technical, and administrative unit operating as part of a battalion. It is highly trained in mobility, tactical and technical functions, and administration, supply, and motor maintenance. The detailed requirements under these headings are as follows:

a. Mobility.—(1) Reconnoiter routes rapidly.

(2) Follow routes with or without the use of maps or map substitutes.

(3) Mark routes rapidly.

(4) March long distances at high rates of speed.

(5) Cross difficult terrain.

(6) Negotiate obstacles and make roadside repairs to motors.

(7) Maintain proper march discipline.

b. Tactical and technical functions.—(1) As far as practicable with the means available, provide its own security and defense against shell fire, air, ground, and gas attacks, in bivouac, on the march, and in position.

(2) Conceal itself from enemy observation by natural and artificial means in bivouac and in position.

(3) Install and operate the command post, fire-direction center, message center, and observation posts for the battalion.

(4) Perform the battalion survey, assisted if necessary by the batteries.

(5) Establish and maintain liaison with supported units.

(6) Construct observation posts, command posts, and protective shelters.

(7) Provide continuous operation of battalion installations during displacement.

(8) Install, operate, and maintain all forms of signal communication used in the battalion nets.

(9) Provide continuous communication during periods of displacement.

(10) Provide antiaircraft and antitank defense as directed by battalion.

(11) Identify friendly and hostile aircraft and combat vehicles rapidly.

(12) Deliver effective fire against enemy aircraft and combat vehicles.

c. Administration, supply, and maintenance.—(1) Maintain a properly organized headquarters section.

(2) Insure an adequate and satisfactory mess.

(3) Select and occupy suitable camp and bivouac sites promptly.

(4) Provide reliefs in all positions so as to function in continuous operations.

(5) Maintain at least one trained replacement for each specialist in the battery.

(6) Provide prompt first aid and evacuation of casualties.

(7) Insure proper care, use, and maintenance of its matériel, motor vehicles, and other equipment.

(8) Insure the timely issue of its equipment, rations, fuel, and other supplies.

(9) Maintain the rear echelon so as to handle effectively all matters of administration, messing, supply, and maintenance.

158. Gun (howitzer) battalion.—The trained gun (howitzer) battalion is able to function efficiently at all times as a tactical and administrative unit operating either in the role of a separate battalion or as part of a larger tactical command. It is highly trained in mobility, tactical and technical functions, and administration, supply, and motor maintenance. The detailed requirements under these headings are as follows:

a. Mobility.—(1) Reconnoiter routes rapidly.

(2) Follow routes with or without the use of maps or map substitutes.

(3) Mark routes rapidly.

(4) March long distances at high rates of speed.

(5) Cross difficult terrain.

(6) Maintain proper march discipline.

b. Tactical and technical functions.—(1) Reconnoiter, occupy, and organize positions expeditiously.

(2) Establish prompt liaison and communication with supported units.

(3) Coordinate the observation system of the battalion so as to cover the sector effectively.

(4) Collect enemy information through the observation, liaison, and command systems for use of the battalion and higher echelons.

(5) Plan and coordinate the survey for the battalion.

(6) Plan and maneuver the fires of the battalion so as to furnish effective support.

(7) Coordinate the defense of the position against air and ground attack.

(8) Allocate the expenditure of ammunition.

(9) Establish and maintain an effective supply of ammunition.

(10) Displace without interrupting the delivery of fire missions, communications, and ammunition supply.

c. Administration, supply, and motor maintenance.—(1) Coordinate the duties of the staff sections to insure continuous operation of forward and rear echelons without interruption of tactical, administrative, supply, and motor maintenance functions.

(2) Qualify in standard operating procedure so as to place any plan into operation with minimum delay.

(3) Handle all matters of administration, supply, and motor maintenance efficiently.

(4) Provide first aid and evacuation of casualties.

(5) Collect and dispose of salvaged supplies.

159. Time limits.—The following table indicates the time limits within which an efficient unit should perform each operation:

Operation performed	Unit performing	Conditions influencing performance	Time limits	Remarks—battery halted in position
Make shelter tent camp.	Battery-----	Ideal—No clearing necessary.	1 to 1½ hours.	
Break camp and resume march.	Battery (horse-drawn).	Ideal-----	45 minutes to 1¼ hours.	
Break camp and resume march.	Battery (truck-drawn).	-----do-----	30 to 60 minutes.	
Break camp, feed breakfast, and resume march.	Battery (horse-drawn).	From reveille to beginning of march.	1½ to 2 hours.	No work before reveille except preparation of breakfast.
Do-----	Battery (truck-drawn).	-----do-----	1 to 1½ hours.	Do.
Prepare for action.	Light battery.	Guns in position.	3 to 5 minutes.	Does not include digging of trail trenches.
Do-----	Medium battery.	-----do-----	5 to 8 minutes.	Do.

Operation performed	Unit performing	Conditions influencing performance	Time limits	Remarks—battery halted in position
Prepare for action.	Heavy battery.	Guns in position.	10 to 15 minutes.	Does not include digging of trail trenches.
Prepare initial firing data, approximate methods.	Officer conducting fire.	Axial and lateral problems.	2 to 3 minutes.	Assisted by other personnel.
Prepare initial firing data, approximate methods, after previous registration.	do	do	1 to 2 minutes.	Do.
Getting off 1st round.	Light battery.	Battery prepared for action and laid on base deflection.	12 to 20 seconds.	From time of announcement of elevation.
Do	Medium battery.	do	15 to 25 seconds.	From time executive receives complete fire commands.
Do	Heavy battery.	do	15 to 30 seconds.	Do.
Prepare initial data for K-transfers.	Officer conducting fire.	Using graphical firing tables.	1 to 2 minutes.	Assisted by other personnel.
Do	do	Without use of graphical firing tables.	5 to 7 minutes.	Do.
Mass fires of battalion on target.	Light battalion.	One battery previously registered. FDC completely organized.	3 to 5 minutes.	By transfer of fire from time coordinates are received.
Do	Medium battalion.	do	3 to 5 minutes.	Do.
Do	Light battalion.	One battery adjusted and firing on target.	2 to 4 minutes.	Other batteries to come in on same target.

160. Observation battery.—The trained observation battery is able to function efficiently at all times as a tactical, technical, and administrative unit operating either in the role of a separate battery or as part of a battalion. It is highly trained in mobility, tactical and technical functions, and administration, supply, and motor maintenance. The detailed requirements under these headings are as follows:

a. Mobility.—(1) Reconnoiter routes rapidly.

(2) Follow routes with or without the use of maps or map substitutes.

(3) Mark routes rapidly.

(4) March long distances at high rates of speed.

(5) Cross difficult terrain.

(6) Negotiate obstacles and make roadside repairs to motors.

(7) Maintain proper march discipline.

b. Tactical and technical functions.—(1) Provide its own security and defense against shell fire, air, ground, and gas attacks, in bivouac, on the march, and in position.

(2) Conceal itself from enemy observation by natural and artificial means in bivouac and in position.

(3) Reconnoiter, occupy, and organize positions expeditiously.

(4) Locate accurately, by survey, all microphones and flash observation posts from the control specified.

(5) Install, operate, and maintain sound-ranging posts and equipment.

(6) Determine sound-ranging locations and caliber of enemy batteries.

(7) Determine sound-ranging locations of individual rounds or groups of rounds fired by friendly artillery.

(8) Install, operate, and maintain flash observation posts and flash-ranging switchboard.

(9) Determine flash-ranging locations of enemy batteries.

(10) Determine flash-ranging locations of individual rounds or groups of rounds fired by friendly artillery.

(11) Install, operate, and maintain the wire communication systems of the battery.

c. Administration, supply, and maintenance.—(1) Maintain a properly organized headquarters section.

(2) Insure an adequate and satisfactory mess.

(3) Select and occupy suitable camp and bivouac sites promptly.

(4) Provide reliefs in all positions so as to function in continuous operations.

(5) Maintain at least one trained replacement for each specialist in the battery.

(6) Provide prompt first aid and evacuation of casualties.

(7) Insure proper care, use, and maintenance of its matériel, motor vehicles, and other equipment.

(8) Insure the timely issue of its equipment, rations, fuel, and other supplies.

(9) Maintain the rear echelon so as to handle effectively all matters of administration, messing, supply, and maintenance.

161. Headquarters battery (observation battalion).—The trained headquarters battery (observation battalion) is able to function efficiently at all times as a tactical, technical, supply, and administrative unit operating as part of a battalion. It is highly trained in mobility, tactical and technical functions, battalion supply and motor maintenance, and battery administration, supply, and maintenance. The detailed requirements under these headings are as follows:

a. Mobility.—(1) Reconnoiter routes rapidly.

(2) Follow routes with or without the use of maps or map substitutes.

(3) Mark routes rapidly.

(4) March long distances at high rates of speed.

(5) Cross difficult terrain.

(6) Negotiate obstacles and make roadside repairs to motors.

(7) Maintain proper march discipline.

b. Tactical and technical functions.—(1) Provide its own security and defense against shell fire, air, ground, and gas attacks, in bivouac, on the march, and in position.

(2) Conceal itself from enemy observation by natural and artificial means in bivouac and in position.

(3) Install and operate the battalion command post and message center.

(4) Establish the survey control for the corps artillery.

(5) Install, operate, and maintain all communication in the battalion nets.

(6) Install and operate the meteorological station.

c. Supply and motor maintenance (battalion).—(1) Procure, distribute, and account for all arms, rations, clothing, equipment, fuel, and other supplies for the battalion.

(2) Supervise all motor-vehicle maintenance in the battalion.

(3) Install and operate supply and motor maintenance facilities for the battalion.

(4) Repair, maintain, and replace motor vehicles, assemblies, and parts.

(5) Perform emergency repairs to vehicles which fall out on the march.

(6) Coordinate and supervise higher echelon repairs to battalion motor vehicles.

(7) Maintain general supervision of motor-vehicle operation and maintenance records of the battalion.

(8) Account for allotted funds expended upon each motor vehicle in the battalion.

(9) Collect, classify, and dispose of salvaged equipment and supplies.

d. Administration, supply, and maintenance (battery).—(1) Maintain a properly organized headquarters section.

(2) Insure an adequate and satisfactory mess.

(3) Select and occupy suitable camp and bivouac sites promptly.

(4) Provide reliefs in all positions so as to function in continuous operations.

(5) Maintain at least one trained replacement for each specialist in the battery.

(6) Provide prompt first aid and evacuation of casualties.

(7) Insure proper care, use, and maintenance of its matériel, motor vehicles, and other equipment.

(8) Insure the timely issue of its equipment, rations, fuel, and other supplies.

(9) Maintain the rear echelon so as to handle effectively all matters of administration, messing, supply, and maintenance.

162. Observation battalion.—The trained observation battalion is able to function efficiently at all times as a tactical and administrative unit as part of a larger tactical command. It is highly trained in mobility, tactical and technical functions, and administration, supply, and motor maintenance. The detailed requirements under these headings are as follows:

a. Mobility.—(1) Reconnoiter routes rapidly.

(2) Follow routes with or without the use of maps or map substitutes.

(3) Mark routes rapidly.

(4) March long distances at high rates of speed.

(5) Cross difficult terrain.

(6) Negotiate obstacles and make roadside repairs to motors.

(7) Maintain proper march discipline.

b. Tactical and technical functions.—(1) Reconnoiter, occupy, and organize positions expeditiously.

(2) Coordinate the employment of its batteries.

(3) Determine the location and caliber of enemy artillery.

(4) Adjust fire for friendly artillery.

(5) Collect, evaluate, and forward enemy information of value as combat intelligence.

(6) Furnish survey control for the artillery with the corps, and meteorological data for the corps artillery.

c. Administration, supply, and motor maintenance.—(1) Coordinate the duties of the staff sections to insure continuous operation of forward and rear echelons without interruption of tactical, administrative, supply, and motor maintenance functions.

(2) Qualify in standard operating procedure so as to place any plan into operation with minimum delay.

(3) Handle all matters of administration, supply, and motor maintenance efficiently.

(4) Provide first aid and evacuation of casualties.

(5) Collect and dispose of salvaged supplies.

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APPENDIX I

FIRING PROGRAM¹

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PHASE I. The battery-----	1-3
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PHASE I.—THE BATTERY

1. Synopsis.—The purpose of this phase is to test the ability of a battery to: occupy and organize its position; install and operate a satisfactory system of communication; execute fire commands; prepare firing data and charts; check matériel; handle and store ammunition in the field; provide close-in security; and, in general, operate alone or as part of a battalion. There is no firing during this phase.

2. Exercise No. 1.—a. Situation.—The battery is ordered into position in a rapidly moving situation. The battery must prepare to execute observed fires. Speed is required.

b. Maps.—None.

c. Requirements.—(1) Pertinent information having been given the battery commander by the director, the battery commander will make the necessary reconnaissance and issue orders for the battery to occupy position.

(2) Fire commands will be sent to the battery to open fire on a target designated by the director. Upon completion of the simulated firing, base deflection will be recorded.

(3) A fire chart will be constructed, based on adjusted data furnished by the director.

(4) The director will cause firing data to be sent to the battery; these data will require the pieces to be laid in a manner other than that used in requirement (2). (Data for a complete adjustment and fire for effect including a zone will be sent to the battery.)

(5) When requirement (4) is completed, the director will require the executive to—

(a) Measure the adjusted compass.

(b) Report the adjusted deflection.

(c) Report the minimum elevation for each charge, type of projectile, and fuze.

(6) Wire communication will be considered broken by enemy fire. A set of fire commands will be sent by radio.

¹This program consists of a series of tests and is furnished as a suggested guide for the use and aid of commanders in the preparation of training directives and programs. It is believed that comprehensive tests of this nature will be an excellent measure of the technical efficiency of field artillery units.

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(7) Radio and wire will be considered not workable. A message will be sent by visual means.

d. Control of exercise.—(1) There will be a director and two assistants for this phase. When this phase opens, the director will meet the battery commander and his party in the vicinity of the position area. The detail and firing battery will be in march column at a distance of about 2 miles. The director will explain the situation, point out the OP, position area, direction of fire, and initial target.

(2) During the reconnaissance the director will have a record made of all orders given by the battery officers. The director and his assistants will divide their duties so that one is with the battery commander, one with the reconnaissance officer, and one with executive at all times.

(3) The accuracy of computation of all data and the proper transmission, execution, and record of all fire commands and messages will be checked. This will include the record kept by the recorder and the accuracy of the work of the gun squads.

(4) For requirement (4), duplicate cards, one for use by director at the OP and one for the director at the battery position, will be prepared with data such as follows:

BATTERY ADJUST

SH HE

CHARGE 5

FUZE QUICK

AIMING POINT, SO AND SO (or COMPASS SO AND SO)

DEFLECTION 1670

ON NO. 2 OPEN 4

SITE 310

BATTERY RIGHT

ELEVATION

370

LEFT 160

370

LEFT 30

382

RIGHT 15

376

BATTERY ONE ROUND

ZONE 6 MILS

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(5) When the battery has completed requirement (4), the director will require the executive to measure the adjusted compass, determine the adjusted deflection, and report minimum elevation.

(6) The director will announce that telephone communication is no longer available and will cause commands similar to those of requirement (4) to be sent by radio and visual means.

e. Grading.—(1) *General.*—In determining the ability of any person or group in the performance of any test, the director should consider the apparent confidence the person or group exhibits in performing the task. There is no place for the nervous and excitable. Severe cuts should be given for disorder, vacillation, repetition, change of orders, and improper sequence of procedure. The method of grading suggested is merely a guide to the director in enabling him to determine the proficiency of units by a uniform yardstick.

	Percent
(2) Reconnaissance and occupation of position.....	20
Orders of battery officers.....	8
Reconnaissance by battery officers.....	5
Selection of positions.....	3
Orderliness of occupation.....	2
Speed	2
(3) Communication	15
Completeness of installation.....	5
Transmission of messages—accuracy and speed....	5
Time for installation.....	5
(4) Firing data and firing chart.....	20
Accuracy of firing angle.....	5
Accuracy of range or elevation.....	4
Accuracy of site.....	3
Sequence of commands.....	1
Time for computation.....	5
Construction of firing chart.....	2
(5) Firing battery.....	45
Prepare for action.....	3
Minimum elevation—chief of sections.....	2
Executive. Initial laying.....	5
Subsequent laying	3
Adjusted compass }	5
Adjusted deflection }	
Minimum elevation	5
Commands	5
Recorder	2
Gun squads.....	15

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(6) For requirements (2) and (4), time will be taken from the initial command to the announcement of the range or elevation. Time will also be taken from initial command to the executive's command FIRE. The director will determine time standards according to the type of matériel.

3. Exercise No. 2.—a. Situation.—The battery is part of a battalion which has been ordered to occupy position. The orienting line has been materialized on the ground.

b. Maps.—Best available maps (or map substitutes) except that the 1/20,000 contoured map will not be used. The battalion will be prepared initially for unobserved fires without registration. Fires are not immediately required but time is limited. The battery will register after the initial firing.

NOTE.—Some of the requirements listed below normally would be accomplished by battalion. However, battery personnel should also be trained in the performance of such operations; for that reason they are included in this exercise.

c. Requirements.—(1) The director will issue a battalion oral field order. The battery commander will cause his battery to occupy and organize the position.

(2) The instrument section will determine map location and altitude of battery position and OP.

(3) Instrument section will determine map location and altitude of two targets.

(4) The base angle will be announced by the director who will also designate the map location of the normal barrage. Map data will be prepared for the barrage and for the targets listed in requirement (3).

(5) A metro message will be delivered to the battery commander, who will cause metro data to be prepared for the barrage and the targets. The data sheet will be completed and sent to battery executive.

(6) Assume that registration is now permitted. The battery commander will send data to guns for an adjustment on the base point. Adjusted data will be given to the battery commander, who will determine a *K* and a deflection correction for *K*-transfers and a *K*-change and a deflection correction change for metro transfers.

(7) The *K* and deflection corrections will be applied to the barrage and targets mentioned in requirement (3). Corrections will be sent to the executive for entry on the data sheet.

(8) A new metro message will be given the battery commander. Data for barrage and targets will be corrected by this message and by the applicable corrections (*K*-change and deflection correction change) determined in requirement (6). New corrections will be sent to the battery executive for entry on the data sheet.

(9) The director will inform the battery commander that his battery has fired a center of impact. This center of impact, as reported by an air observer, is plotted on a single vertical photo, and will be restituted from the vertical photo to the firing chart; corrections will be determined for future firing.

(10) Simulate firing on barrage and targets with latest data.

(11) Sometime after requirement (6), the director will cause the pieces to be displaced laterally, or the near aiming stake for each piece to be moved slightly. The correction for lateral displacement will be made.

d. Control of exercise.—(1) Prior to the exercise the director will accomplish the following:

- (a) Stake out orienting line.
- (b) Select base point and targets and determine the base angle.
- (c) Determine the coordinates and altitude of a point in the position area from which battery survey will be initiated.
- (d) Prepare the oral battalion field order. (See (2) below.)
- (e) Prepare to indicate the normal barrage on the firing chart.
- (f) Prepare two dissimilar and logical metro messages.
- (g) Prepare logical adjusted data for the base point.
- (h) Prepare air photo and initial data for requirement (9).

(2) The director will give a battalion oral field order covering such of the following items as are applicable; items covered should include all those marked with an asterisk.

Take notes.

Number of order.

*General orientation.

*Designation of base point and reference point.

Information of the enemy.

Plan of supported troops; line of departure.

*Mission of the artillery battalion.

*Zone of fire.

Zones of observation.

*Observation posts.

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*Position.

*Instructions for AA and AT security.

*Instructions for local security against enemy ground and parachute troops.

Instructions relative to construction of obstacles and the laying of antitank mine fields.

*Firing chart.

*Plan of survey.

*Registration.

*Minimum range line.

Instructions for forward observers.

Instructions for ammunition supply.

Position of the battalion ammunition train.

Location of aid station.

Plan of signal communication.

Location of battalion command post.

Location of battalion commander or his representative until command post opens.

*Where and when batteries are to be released.

Synchronize watches.

Questions.

(3) The director should have two commissioned assistants.

(4) The battery position area should require the erection of artificial camouflage for at least one section and initiation of field fortification.

(5) Targets should be so selected that to locate them will require either long- or short-base intersection, and they should have a difference in range which will require a different charge for each; however, one target should be within transfer limits of the base point.

(6) The correctness of all locations, such as battery position and OP, can be checked after exercise is completed. Map data, metro data, metro-transfer data, and *K*-transfer data may likewise be checked after the exercise.

(7) Accuracy and correctness of all settings made by the gun crews should be checked.

e. Grading.—(1) *General.*—The grading of this exercise will depend somewhat on local conditions of terrain, available maps, weather, and type of matériel.

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	Percent
(2) Firing battery-----	50
(a) <i>Organization of position.</i>	
Camouflage—preparation of and maintenance--	4
Defense against ground attack—Prearrangement of antitank fires, sentinels, warning system----	5
Defense against air attack-----	3
Laying of battery by executive-----	3
Preparation and improvement of position-----	10
Check of sights, quadrants, and range quadrants (prior to firing)-----	5
Minimum elevation-----	2
Storage of ammunition-----	3
Displacement correction-----	2
(b) <i>Fire commands.</i>	
Correction of data sheet-----	3
Section data sheets for barrage-----	2
Execution of fire commands:	
Accuracy -----	5
Speed -----	3
(3) Survey -----	20
Location and altitude of guns and OP-----	8
Location and altitude of targets-----	12
(4) Map data-----	5
(5) Determination and application of corrections-----	25
Metro-data and metro transfers-----	12
K-transfers -----	8
Speed-----	5

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PHASE II.—THE BATTALION

1. **Synopsis.**—The battalion phase is divided into three exercises. The exercises require the use of various types of firing charts, and vary from a fast-moving situation to one permitting a deliberate occupation of position. Although three distinct exercises are drawn up, they are not necessarily separate; two or more firing charts may be in operation or under construction at the same time. For example, an observed-fire chart, based on the result of registration will normally be constructed while survey is in progress. Upon completion of the survey a firing chart is constructed; data concerning targets may be taken from the observed fire chart and entered on the surveyed firing chart. The firing chart may then be used for the determination of data for both observed and unobserved fires, and the observed-fire chart may be discontinued.

2. **Exercise No. 1.**—*a. Situation.*—The battalion is ordered into action in a fast-moving situation. No maps, map substitutes, or aerial photographs are available at this time. No preliminary survey is possible. Preparations should be made for all forms of observed fires. OP's are established for axial or lateral conduct of fire; forward observers are posted; arrangements are made for air observation.

b. Requirements.—(1) The director explains the situation to the battalion commander and points out to him the battalion position area on the ground. The battalion makes the necessary reconnaissance and occupies the position.

(2) Batteries register on the battalion base point selected by the battalion commander.

(3) From adjusted data sent to the battalion fire-direction center an observed fire chart is constructed.

(4) A forward observer requests the fire of the battalion on a target. The battalion commander directs the mission be fired; the center battery is used for adjustment; the battalion fires for effect.

(5) An air observer requests, "Mark base point." (No preliminary conference has been held between the air observer and the battalion staff.) The air observer then reports a target with respect to the marked base point. The battalion commander directs that the right battery adjust and the battalion fire for effect.

(6) A battery officer of each battery makes a bracket adjustment on a target of opportunity. He reports the target to the fire-direc-

tion center; is directed to fire on it; and reports the result to the fire-direction center upon completion of the mission.

(7) The fire-direction center is neutralized by hostile fire. The air-ground radio set (displacing to the battery position if necessary) operates with the left battery, and a battery mission is fired on a target reported by the air observer.

c. Control of exercise.—(1) The director of the exercise is responsible for safety. Where target ranges are limited, stakes for base pieces and OP's may be placed in advance of the exercise.

(2) No officer will fire more than one problem.

(3) The forward observers should be well forward. They may occupy dugouts. In any case the safety provisions of AR 750-10 should be complied with.

(4) Targets should be plotted in advance and observers placed to report on the accuracy of fires. Targets should not be designated to battalion officers until just before firing.

(5) The air observer should be a member of the battalion, if an officer who has had the observation course is available; otherwise procedure of the air observer will not be charged to the battalion in grading.

(6) The firing chart and all records kept by batteries and battalion will be turned in to the director at the conclusion of the exercise.

d. Grading.

	<i>Percent</i>
(1) Reconnaissance and occupation of position-----	15
Speed in reconnaissance and selection-----	5
Choice of positions-----	5
Orderliness of occupation-----	5
(2) Registration on base point-----	18
Adequacy of base point selected-----	3
Registrations (each battery 5 percent)-----	15
(3) Reporting of adjusting data and construction of chart-----	12
Prompt and correct report-----	3
Constructing chart (each battery 3 percent)-----	9
(4) Forward observer adjustment-----	15
Forward observers' procedure, accuracy of adjustment, and promptness of action-----	5
Procedure, accuracy, and promptness in fire-direction center-----	5
Effect of fire of the battalion-----	5

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	Percent
(5) Air observation adjustment.....	15
Adjustment and procedure, including communica- tion, in fire-direction center. (Use scale for for- ward observer ((4)a above) if air observer is a member of battalion.).....	10
Effect of fire of the battalion.....	5
(6) Bracket adjustments.....	15
Each adjustment to be judged on speed, accuracy of initial data, procedure, and correctness of final bracket.....	5
(7) Air adjustment by battery.....	10
Arrangements in the battalion for decentralization and procedure in starting adjustment.....	5
Procedure during adjustment and effectiveness of fire.....	5

3. Exercise No. 2.—a. Situation.—The battalion will occupy position under cover of darkness to support an attack early the next day. One hour of daylight, modified if necessary to meet local conditions, will be allowed for reconnaissance and commencement of survey operations. Such survey operations as have not been completed in daylight will be completed after dark. Photo-maps (wide-angle photos or mosaics) are available and will be used as a firing chart. Registration will not be permitted before the start of the preparation preceding the attack. Battalions will be prepared to deliver fires using metro data during the preparation.

b. Requirements.—(1) The battalion commander will select positions on the ground designated by the director.

(2) The battalion commander will make his reconnaissance and will direct the order in which survey operations will be performed in order to insure completion of essential operations before dark. The survey by the battalion includes—

- (a) Establishment of direction.
- (b) Establishment of vertical control.
- (c) Determination of scale of the photo.
- (d) Transmission of direction to the battalion orienting line.
- (e) Horizontal location of base pieces by direct identification or short traverse.

NOTE.—Battery details will assist in survey operations under the direction of the battalion reconnaissance officer.

(3) Occupation of position, which will include laying batteries on the common base point; occupation will be after dark.

(4) At daylight, each battery of the battalion will fire in turn on the same target designated by coordinates and assumed to be one of the prearranged fires. Metro data will be used.

(a) The latest metro message will be furnished to the battalion fire-direction center one-half hour before opening fire.

(b) The target on which fire is to be massed will be assigned the battalion. It will be designated by coordinates.

(5) The base piece of the center battery will register on the base point; the adjusted data will be furnished the fire-direction center. Personnel of the fire-direction center will determine deflection and elevation correction, and will be prepared to apply these corrections to targets.

(6) A target, designated by coordinates, will be furnished the battalion commander. The fire-direction center will determine the corrected data and fire each battery, in turn, using *K*-transfers.

(7) The fire-direction center will direct the air observer to spot a center-of-impact registration. The instructions given to the air observer by the battalion commander or his representative will be part of the problem for purpose of grading.

(8) The air observer will report the coordinates of a target, and the battalion will mass fires on this point, after applying appropriate *K*-transfer corrections obtained from the air center-of-impact registration.

c. Control.—(1) The director is responsible for safety. He may have to stake out locations for base pieces prior to the occupation of these positions where firing areas are limited.

(2) All survey notes and calculations, as well as firing charts and computers' records for the entire exercise, will be turned over to the director at the conclusion of the exercise.

(3) Targets should be plotted in advance by the director and observers placed in order to report on the accuracy of fires. The targets of requirements (4)(b) and (8) should not be prearranged fires but should be designated approximately 5 minutes in advance of the time of firing. The air observer should be a member of the battalion if an officer who has had the observation course is available.

(4) The procedure used in occupying the position will depend entirely on local conditions. The time of opening fire may be delayed by local safety regulations; tactical considerations may of necessity be discarded.

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(5) Batteries should fire one at a time in order to check accuracy of fire. Batteries should fire with 100-yard sheafs centered on the point target.

d. Grading.

	<i>Percent</i>
(1) Reconnaissance and occupation of position-----	10
Speed in reconnaissance and selection-----	3
Choice of position-----	3
Orderliness of occupation-----	4
(2) Survey-----	25
Plan-----	5
Rapid and vigorous execution-----	10
Accuracy-----	10
(3) Massing of fire (metro data)-----	15
Accuracy of corrections-----	10
Effectiveness of fire-----	5
(4) Registration-----	10
Accuracy of adjustment-----	10
(5) Massing of fire (<i>K</i> -transfer)-----	15
Accuracy of corrections-----	10
Effectiveness of fire-----	5
(6) Registration-----	10
Accuracy of location of air C. I-----	10
(7) Massing of fire (<i>K</i> -transfer)-----	15
Accuracy of corrections-----	10
Effectiveness of fire-----	5

4. Exercise No. 3.—*a. Situation.*—This exercise is designated to test the survey parties of the battalion in a situation requiring a complete survey; the tactical situation is incidental. The battalion is ordered into action in a situation in which deliberate occupation is possible. No maps, map substitutes, or aerial photographs are available at the start of the exercise. A complete grid sheet survey will be required. (This exercise, in most terrain, will require a full day.)

b. Requirements.—(1) The director will explain the situation on the ground, and will point out the battalion position area to the battalion commander. Necessary reconnaissance will be made; survey plans will be formulated and a complete survey on a grid sheet will be made. Battery survey details will operate under battalion control.

(2) Survey to be performed.

(a) An origin will be given arbitrary coordinates, and altitude and a direction will be established to a point in the target area.

(b) A directional and distance traverse will be run to the battalion orienting line.

(c) Accurate place marks will be established. (One or two place marks should suffice for the battalion.)

(d) Batteries will determine their locations with respect to the place marks.

(e) A battalion base point will be located.

(f) As many other points of varying altitude as can be seen will be located in the target area. Altitudes of such points in the target area will be determined.

(g) Lateral observation posts will be established for high-burst or center-of-impact registration.

(h) A reference point to be used with the high-burst or center-of-impact adjustment will be located.

(3) All elements, including firing batteries, will occupy positions as soon as such positions have been located or selected.

(4) One battery will be required to register, using high bursts or a center of impact.

(5) Deflection and elevation corrections will be determined by the fire-direction center from the results of registration.

(6) The director will select one of the points surveyed by the battalion and have the battalion mass its fires on this point (*K*-transfer).

(7) The director will select another point which has been surveyed by the battalion as a check point and will require one of the batteries to register with a precision adjustment. This check point will be outside of the transfer limits of the point upon which the center of impact or high burst was made. The director will deliver a metro message just prior to this registration.

(8) The fire-direction center will be required to determine deflection and elevation corrections for the check point in requirement (7).

(9) The director will select a surveyed point within the transfer limits of the check point used in requirement (7), and require the battalion to mass its fire on this point (metro transfer).

c. Control.—(1) The director is responsible for safety. Where target ranges are limited, stakes for base pieces and OP's may be placed in advance of the exercise.

(2) Observers should be placed so as to determine the accuracy of fires. Since in this situation the targets are not known in advance, it may be necessary to delay the exercise while the observers are shown the targets. Where air photographs are available, targets may be marked thereon and an air observer directed to indicate on such photo

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the centers of impact of the fires of the batteries with respect to the targets (this to be in lieu of ground observers).

(3) The director will obtain the metro message for requirement (7).

d. Grading.

	Percent
(1) Reconnaissance and occupation of position-----	15
Speed in reconnaissance of selection-----	5
Choice of position-----	5
Orderliness of occupation-----	5
(2) Survey-----	25
Plan -----	5
Rapid and vigorous execution-----	5
Accuracy of locations in position area-----	5
Accuracy of locations in target area-----	5
Choice and location of OP and reference point----	5
(3) Registration-----	5
Accuracy of location of high burst-----	5
(4) Massing of fires (<i>K</i> -transfers)-----	25
Accuracy of corrections-----	15
Effectiveness of fire-----	10
(5) Registration-----	5
Accuracy of adjustment on check point-----	5
(6) Massing of fires (metro-transfers)-----	25
Accuracy of determining metro corrections-----	5
Accuracy of applying registration corrections-----	10
Effectiveness of fire-----	10

PHASE III.—THE ARTILLERY OF THE DIVISION—THE FIELD ARTILLERY BRIGADE

1. Synopsis.—For this phase, it is assumed that the training of the individual battery and battalion has been completed, and that these units are technically qualified to participate in a coordinated division or brigade exercise. In the test of the artillery of the division (brigade) only accurate fires (transfers and metro data) will be employed. The object of the exercises is to test the technical aspects of fire direction as exercised by the artillery commander in coordinating the fires of the battalions through the battalion fire-direction centers and the capabilities of the survey and metro sections of the units. This phase is divided into three exercises with varying topographic data available as the basis of a firing chart.

2. Exercise No. 1.—*a. Situation.*—The artillery will occupy positions under cover of darkness to support an attack which will take place at daylight. Photo-maps (wide-angle photos or mosaics) are available and will be used as a firing chart. Registration prior to the attack is not permitted. Battalions will be prepared to deliver accurate fires (metro data) during the preparation. Three hours of daylight remain for reconnaissance and survey.

b. Requirements.—(1) The selection (or designation by the director) of positions for the battalions and batteries.

(2) The performance of survey by the survey personnel of all units in the various echelons to include—

(a) *Division (brigade).*

1. Establishment of direction. (The map locations of points so used will be corrected for distortion.)

2. Establishment of vertical control.

3. Determination of scale.

(b) *Battalions.*

1. Carry the direction established by division to the batteries.

2. Establish horizontal control.

3. Extend vertical control.

4. Prepare a firing chart.

(3) Occupation of position.

(4) Massing of the fire of all battalions at daylight on the same point (metro data).

(a) Determination of a metro message by the division artillery metro section and its transmission to battalion fire-direction centers.

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(b) Calculation of deflection and range corrections for at least one point in the target area.

(c) Assignment of a target.

1. If fires have been prearranged, targets may be marked on a vertical air photo and sent to the fire-direction center in time to be restituted to the firing chart.
2. If no prearrangement is made, a target may be designated by coordinates (point-designation grid) after determination of metro corrections.

(5) Determination by an air observer of a center of impact for each battalion; determination by each battalion of a deflection correction and a *K*.

(6) Massing of the fire of all battalions on the same point (*K*-transfer).

c. Control.—(1) The director is responsible for safety and may of necessity have to prescribe the positions to be occupied; he may even have to stake positions on the ground.

(2) All survey notes and calculations, as well as the firing charts used by all units during the entire exercise, will be turned over to the director at the conclusion of the exercise.

(3) Procedure used in occupation of position will depend entirely on local conditions. Time of opening fire may be delayed by local safety regulations, and tactical considerations may of necessity be discarded.

(4) Provisions will be made to check accuracy of fire on all targets. Fire, although on one point, will be by battalion in order that each battalion may be checked individually.

(5) The air observer, for the air centers of impact, should be from the division; otherwise the accuracy of the locations cannot be charged to the division in grading. Provisions must be made for a check of the accuracy of location of centers of impact as well of subsequent concentrations.

(6) As an aid in placing responsibility for errors which may occur in delivery of fires, copies of the metro message, the calculations to determine deflection and *K*-corrections, the data used to determine deflection corrections, the *K* used for *K*-transfers, and the computers' records will be furnished the director.

d. Grading.

	Percent
(1) Reconnaissance and occupation of position-----	15
Speed in reconnaissance and selection-----	5
Choice of positions-----	5
Orderly occupation-----	5

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	Percent
(2) Survey-----	25
Plan-----	5
Rapid and vigorous execution-----	10
Accuracy-----	10
(3) Massing of fires (metro data)-----	25
Accuracy of corrections-----	15
Effectiveness of fire-----	10
(4) Air centers of impact-----	10
Accuracy of locations-----	10
(5) Massing of fires (<i>K</i> -transfers)-----	25
Accuracy of corrections-----	15
Effectiveness of fire-----	10

3. Exercise No. 2.—a. Situation.—The artillery of the division (field artillery brigade) has been directed to occupy positions with the mission of supporting an attack. No maps, map substitutes, or aerial photographs are available at the start of the exercise. Registration is not permitted prior to the preparation. Time is available for a deliberate survey. A complete grid-sheet survey is required.

b. Requirements.—(1) The selection (or designation by the director) of positions to be occupied by the battalions and batteries. (In case the positions are not specified and staked out by the director, a ground reconnaissance as directed by the division artillery commander (field artillery brigade commander) will be necessary in view of the fact that no maps are available.)

(2) Survey.

(a) *Division (brigade).*

1. The selection of a point of origin, to which arbitrary co-ordinates and an arbitrary altitude are assigned.
2. The assignment of arbitrary direction to the line joining the point of origin and some point in the target area. (The coordinates of this point will be determined later.)
3. The running of a traverse carrying direction, distance, and altitude to some point either in the position area of each battalion or close thereto.
4. The locating of as many points as possible in the target area and the determination of their altitudes.

(b) *Battalions and batteries.*

1. The running of a traverse carrying direction, distance, and altitude from the control point furnished by division to the battalion orienting line.

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2. Determination of battery locations.
3. Location of base and check points.
4. Location of as many other points of varying altitudes as can be identified in the target area; determination of their altitudes.
5. Establishment of lateral observation posts; location of a reference point for high-burst or center-of-impact registration.

(3) Occupation of positions; laying of batteries.

(4) Metro message will be compiled by division artillery and furnished to the battalion fire-direction centers one-half hour before the time of opening fire.

(5) Metro data. The fire of all battalions will be massed on a point to be selected by the director. (This point may be a point surveyed by the division or a point located by the director with respect to the arbitrary coordinates established by the division.)

(6) Each battalion will register by high bursts or a center of impact. A deflection correction and a K will be determined. (The corrections of each battalion may be transmitted to the division artillery section in order that they may be available to other battalions of the division.)

(7) K -transfers. The fire of all battalions will be massed in turn on a point.

c. Control.—(1) The director is responsible for safety, and may of necessity have to prescribe the positions to be occupied; he may even have to stake positions on the ground.

(2) All survey notes and calculations, as well as the firing charts used by the units during the entire exercise, will be turned over to the director at the conclusion of the exercise.

(3) The procedure used in the occupation of position will depend entirely upon local conditions. Time of opening fire may be delayed by local safety regulations, and tactical considerations may of necessity be discarded.

(4) Provisions will be made to check the accuracy of fire on all targets. Fire, although on one point, will be by battalion in order that each battalion may be checked individually.

(5) As an aid in placing responsibility for errors which may occur in the delivery of fire, copies of the metro message, the calculations to determine deflection corrections and the K , the data from the high-burst registration which is used to determine deflection corrections and the K used for K -transfer, and all computers' records will be furnished the director.

<i>d. Grading.</i>	<i>Percent</i>
(1) Reconnaissance and occupation of position-----	15
Speed in reconnaissance and selection-----	5
Choice of position-----	5
Orderliness of occupation-----	5
(2) Survey-----	25
Plan-----	5
Rapid and vigorous execution-----	10
Accuracy-----	10
(3) Massing of fires (metro data)-----	25
Accuracy of corrections-----	15
Effectiveness of fire-----	10
(4) Registration-----	10
Accuracy of location of center of impact (high burst)-----	10
(5) Massing of fires (<i>K</i> -transfers)-----	25
Accuracy of correction-----	15
Effectiveness of fire-----	10

4. Exercise No. 3.—*a. Situation.*—The division (part of the I Army Corps) is attacking at daylight. The artillery of the division (field artillery brigade) has the mission of supporting the attack. Photo maps (wide-angle photos or mosaics) are available and will be used as a firing chart. The field artillery observation battalion will locate points in the division area with respect to the corps grid system, and will furnish the coordinates and altitudes of these points to the division. Registration is not permitted prior to the preparation. Three hours of daylight remain for reconnaissance and survey.

b. Requirements.—(1) The selection (or designation by the director) of position to be occupied by the battalions and batteries.

(2) Reconnaissance will be made and as much survey as possible completed before dark.

(3) Survey.

(a) *Division (brigade).*

1. *Wide-angle photo.*

(a) Establishment of direction.

(b) Establishment of vertical control.

(c) Determination of scale.

2. *Grid sheet.*

(a) Identify points in the division area which were located by the observation battalion, and transmit

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the coordinates and altitudes of these points to the battalion.

(b) Extend the survey to the battalion area if necessary.

(b) *Battalions.*

1. *Wide-angle photo.*

(a) Carry the direction established by division to the batteries.

(b) Establish horizontal control.

(c) Extend the vertical control.

(d) Prepare a firing chart.

2. *Grid sheet.*

(a) Run a direction and distance traverse from points located by the observation battalion to the battalion orienting line.

(b) Locate batteries with respect to the corps grid system.

(c) Locate base and check points with respect to the corps grid system.

(d) Prepare a firing chart.

(4) Positions will be occupied and the batteries laid.

(5) The metro message will be compiled and furnished to the battalion fire-direction centers one-half hour before the time of opening fire.

(6) *Metro data.* The fire of all battalions will be massed on points to be selected by the director. (The director will designate one target on each firing chart.)

(7) Each battalion will register either by high burst or center of impact, or on a point common to both firing charts. A deflection correction and a *K* will be determined for each firing chart. (The corrections of each battalion will be transmitted to the division artillery section in order that they may be available to other battalions of the division.)

(8) *K-transfers.* The fire of all battalions will be massed on points to be selected by the director. (The director will designate one target on each firing chart.)

c. Control.—(1) The director is responsible for safety and may of necessity have to prescribe the positions to be occupied; he may even have to stake positions on the ground.

(2) All survey notes and calculations, as well as firing charts used by the units during the entire exercise, will be turned over to the director at the conclusion.

(3) The procedure used in the occupation of position will depend entirely upon local conditions. Time of opening fire may be delayed by local safety regulations, and tactical considerations may of necessity be discarded.

(4) Provisions will be made to check the accuracy of fire on all targets. Fire, although on one point, will be by battalion in order that each battalion may be checked individually.

(5) As an aid in placing responsibility for errors which may occur in the delivery of fire, copies of the metro message, the calculations to determine the deflection corrections and the K , the data from the registration which are used to determine the deflection correction and K used for K -transfer, and all computers' records will be furnished the director.

(6) Where an observation battalion is available, the grid sheet survey will be initiated by that unit. If the artillery of the division is operating alone during the test, the director will have to arrange for the necessary preliminary survey to locate points with respect to corps grid system.

(7) This test offers the director an opportunity to exercise ingenuity in testing the observation battalion of the field artillery brigade. By use of lights and explosives (TNT) this unit may be required to locate targets by both flash and sound. In the event that this procedure cannot be carried out, it will be necessary for the director to survey the locations of these targets.

d. Grading.

	Percent
(1) Reconnaissance and occupation of position-----	10
Speed in reconnaissance and selection-----	3
Choice of position-----	3
Orderliness of occupation-----	4
(2) Survey -----	25
(a) <i>Photo map.</i>	
Plan -----	5
Rapid and vigorous execution-----	5
Accuracy-----	5
(b) <i>Grid sheet.</i>	
Rapid and vigorous execution-----	5
Accuracy -----	5
(3) Massing of fires (metro data)-----	30
(a) <i>Photo map.</i>	
Accuracy of corrections-----	10
Effectiveness of fire-----	5

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		Percent
(b) <i>Grid sheet.</i>		
Accuracy of corrections.....	10	
Effectiveness of fire.....	5	
(4) Registration		5
Accuracy of location or adjustment.....	5	
(5) Massing of fires (<i>K</i> -transfers).....		30
(a) <i>Photo map.</i>		
Accuracy of corrections.....	10	
Effectiveness of fire.....	5	
(b) <i>Grid sheet.</i>		
Accuracy of corrections.....	10	
Effectiveness of fire.....	5	

APPENDIX II

SUGGESTIONS FOR TRAINING A FIRING BATTERY

	Paragraph
General.....	1
Suggestions for executive.....	2
Service practice.....	3
Night occupation.....	4

1. **General.**—*a.* The goal of all firing-battery training is fire discipline, which amounts to accuracy, speed and dependability, regardless of adverse conditions, in placing fire where called for and when. No matter how expert an artillery unit may be in other departments, if its batteries cannot shoot reliably, it is useless. Fire discipline is not as common an attribute as many seem to think. It is often taken for granted in places where it does not exist. The task of developing it falls to the battery executive who commands and trains the firing battery.

b. The executive should be selected with care, disregarding seniority as the situation may demand. Leadership, intelligence, and enthusiasm of the contagious variety—properly tempered with common sense—are the essential requirements. Why leadership? More, perhaps, than any other field artillery officer the executive has direct command of men. Intelligence? This is one of those places where an unintelligent individual can do the most harm. Enthusiasm? The firing battery is no place for boredom. Once a good executive becomes identified with a battery and unless exigencies demand otherwise, he should be left where he can best further the combat efficiency of the command; namely, functioning as battery executive.

c. In war there are losses. It is necessary that all battery officers, all first sergeants, and as many chiefs of section as possible be sufficiently grounded in the duties of the executive to take them over in emergency.

d. It is not possible to develop executives merely by sending them to school or by requiring them to read training manuals. Literature on the firing battery is of necessity in brief and concise form; portions may have little meaning to one who is without experience in firing service ammunition; and during a large-scale expansion of the Army there are bound to be many such. In appropriate cases it is

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very helpful, as soon as the student executives have had sufficient firing-battery instruction to enable them to comprehend, to let them witness an informal demonstration. Such a demonstration is actually detrimental unless it is good. The firing battery should be a fairly proficient one. However, a few errors on the part of the battery may furnish some good instruction material. The demonstrating executive must be thoroughly competent and a good instructor. The demonstration should be an ordinary service practice. The executive should go through all the details of reconnoitering his position, supervising the occupation, and executing fire missions. He should explain each operation in detail as he performs it. He should answer all questions as they arise. The number witnessing such a demonstration should be small, not more than six or eight, so that all may follow the executive about and still not get in the way.

2. Suggestions for executive.—*a. Literature.*—Full use should be made of the Field Manual of the 6-series on the service of the piece that pertains to the armament of the battery; also of that portion of FM 6-40 pertaining to the firing battery.

b. Key men to be understudied.—In war there are casualties. In peace there are guard, special duty, sick, and others. A battery will never have, both available for duty and properly trained, its entire complement of men; yet to be an efficient combat unit it must be able to replace its own key-position casualties without being thrown off stride. This calls for a very complete system of understudies. As a practical goal the following will be difficult to exceed:

(1) *Chiefs of section.*—Each to be understudied by his gunner and by one other who can also function as gunner.

(2) *Gunners.*—In each section have three capable substitute gunners, including the man mentioned in (1) above.

(3) *Number one cannoneers.*—Each section to have, in addition to the foregoing, from one to three spare "number ones." The importance and responsibility of this position vary considerably with the type of weapon served.

(4) *Recorders.*—Keep at least three of these on hand, thoroughly trained.

(5) *All enlisted men.*—Have every enlisted man—clerk, cook, or any other specialist—so trained basically that a few minutes of refresher instruction will qualify him to fill passably well any position in the gun squad other than that of gunner (and possibly number one).

c. Training: individual, section, and battery.—First comes the training of the individual cannoneer and of the various “teams” (ammunition handlers, loaders, trail-shifter and gunner, etc.) within the section. Following this, and overlapping it considerably, comes training by section. Both require the supervision of the executive; to just what extent depends largely on the experience and ability of the chiefs of section. In any event the executive must plan and coordinate the work in advance. Overlapping the section training, in turn, is the drill of the firing battery. Unless the latter is handled intelligently it is sure to become a deadly bore. Drill has to be fast, with something doing every minute. It defeats its purpose if periods are too long. An hour is about the practical maximum. The average battery should be able to spend such an hour profitably about as follows:

15 minutes individual instruction.

10 minutes training by section.

During these periods the executive and his assistant, if any, move about and observe, taking such part in the instruction as may appear advisable.

5 minutes rest.

15 minutes battery drill in service of the piece.

5 minutes rest.

10 minutes battery drill in service of the piece.

d. Discipline.—(1) When the firing battery is at attention see that all men are keenly aware of the fact; *require every man to keep his eyes on the executive except while performing a duty that prevents.* This latter procedure furthers alertness to a marked degree. Never keep the gun squads at attention without good reason. Give AT EASE or REST whenever possible, even if for only a few seconds. The men will react to this consideration by giving their undivided attention when called for.

(2) Conversation among the members of a gun squad that is at attention indicates either an atmosphere of uncertainty or a total lack of discipline. Whenever you notice such conversation in a section, either at drill or when firing, call the piece out of action and do not let it fire until you have had a chance to investigate.

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(3) Make it a rule never to allow play or smoking in the immediate vicinity of the pieces. For such purposes require the men to be at least 10 yards in rear of the trails or make other reasonable restrictions, depending on circumstances; in any event, give the men ample opportunity to smoke and otherwise to enjoy themselves.

e. Place for training.—The average gun park is not likely to be a satisfactory place to train the firing battery. There will be noise, dust, traffic, and all manner of interference. Therefore try and make the necessary arrangements, as early as possible, to march the battery away from park to a place of your own choosing and work there. This will also afford considerable practice in reconnaissance and occupation of position.

f. Prepared fire commands.—These are virtually indispensable if the drill is to be fast-moving and interesting. One good idea is to make up in india ink several sets of data on cards according to something like the following scheme: There are two cards to the set. One of these bears only fire commands. The other bears the same commands and, in addition, the resulting correct settings for all pieces. The card that bears both commands and settings affords the executive an instant check on any setting in the battery and also on the recorder(s). From the companion card some designated individual reads the fire commands, in the desired tempo, to T3 (the telephone operator at the simulated OP). Have a case for these cards and make it a practice always to have them with you during duty hours. Make up new sets of data from time to time. Otherwise the men will come to know the answers. Figure 1 shows a typical pair of fire command cards. A card 3 by 5 inches will accommodate about four drill problems of four or five sequences of commands each. The problem shown, No. 17, is for the 155-mm howitzer firing time-fuzed shell. If a percussion fuze were designated, its nature, as Q (quick) or D (delay), would appear in the "fuze" column instead of Kr. and Ti.

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Proj	C h g	Fuze		⊙	Si	MF	Rn or El	4	3	2	1	BD
		Kr	Ti					2129	2133	2140	2143	
HE	4	60	20.4	BD RR 160; FP Op 12.	310	FP 1 RS	372	2005	1997	1992	1983	
			21.4	RR 72		BA RR	392	1933	1925	1920	1911	
		65	20.9	Up 5; LL 36; TP C14.			382	1965	1961	1960	1955	
		62	21.2	Dn 3; RR 18; LP Op 2.	320	BA 1 RS	387	1947	1941	1938	1931	
				⑬								

⑬	Shell HE; Charge 4; Kr 60; Ti 20.4; BD RR 160; On No. 1 open 12; Si 310; No. 1 one round; El 372 # Ti 21.4; RR 72; Btry right; El 392 # Up 5; Ti 20.9; LL 36; On No. 3 close 4; El 382 # Down 3; Ti 21.2; RR 18; On No. 4 open 2; Si 320; Btry 1 round; El 387 ##
⑭	

FIGURE 1.—Fire command cards.

g. Precision of settings and laying.—(1) Require exactness in settings and in laying. “Very close” will *not* do. The slightest leeway permitted in drill will multiply itself by two or three in firing. Insist upon uniformity as to the final motion in making settings and in laying, thus insuring that backlash (slack—lost motion—play) is consistently taken up in that direction which will minimize its effect. With breech-heavy matériel the last motion in laying for elevation (range) is breech upward (bubble front to rear). The final centering of a bubble is usually best accomplished by “tapping” the handwheel. The final motion in laying for direction is muzzle left to right. The last motion in setting the panoramic sight is to

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increase the reading (thumb to the left). After satisfying himself that is panoramic sight is properly cross-leveled, and before calling "Ready," the gunner should take up the backlash in the sight mount by twisting the sight head lightly to the left. If the vertical hair does not then come to rest exactly on the aiming point he must again traverse on.

(2) Most experienced executives require all gunners to use the movable micrometer index (often referred to as the follower or the gunner's aid), that is, to discard all mental arithmetic and use the panoramic sight as an adding machine. Some gunners rather fancy themselves as mental calculators. A few really *are* good. In deciding whether to let a clever one do his calculating in his own way consider how well the mental arithmetic is likely to stand up against fatigue, foul weather, hostile counterbattery, and the various other inconveniences of war. These movable micrometer indexes require a daily check by the executive. When one of them gets out of adjustment and sticks, as all have a way of doing, it carries the micrometer with it and thus causes deflection errors.

h. Time fuzes.—(1) Uniform results in time fire are hard to get. The battery can do nothing about that dispersion which is inherent in the fuze itself. It can do much to prevent those additional errors which are due to faulty fuze setters, careless settings, haphazard cutting, inept loading, or a combination of these. Inspect fuze setters frequently and keep them free from brass filings and other foreign matter. Insist that fuzes be cleaned before insertion in the instrument. Drill cannoneers who cut fuzes to aline the fuze lug carefully with the fuze-setter slot before inserting the round. Otherwise several fruitless turns of the round may result before lug and slot engage, thus wasting time and not contributing to accuracy. In removing the round from the fuze setter, train the cannoneer to keep applied to it a slight torque in the direction of cutting-rotation; this counteracts any tendency to "back off" the setting when withdrawing the round.

(2) All must be keenly conscious of the danger involved in allowing anything, especially the breech of the recoiling piece, to strike a fuze that has been cut. Handle such rounds with respect. The foregoing applies with equal force to any fuzed round. With fixed ammunition the loader inserts the round gently (thus guarding against accidental change in the time setting as well as acting in the interests of safety) for about $\frac{2}{3}$ of its length, then shoves it home.

(3) At drill the fuze cutting goes unverified more often than not. The surest way to check it is for the executive, instead of command-

ing **FIRE** when all sections are ready, to form the cannoneers in rear of their pieces and carefully to unload each piece himself, note the time of burning and then see if he can recut the fuze to a different reading with the same fuze-setter setting. He also sees whether the torsion applied in cutting the fuze has altered the settings on the fuze setter. If so, it is probable that the operator of the instrument failed to make his last motion in the proper direction. At such a check all fuzes should read the same. In any event all fuze setters must, with the same settings, give identical results on the same individual fuze. If this test fails, have the fuze setters adjusted.

(4) A quicker check, though not so precise or thorough, is to command **UNLOAD; READ TIME OF BURNING**, then verify the reading on at least one fuze (to offset any tendency toward reading with fictitious uniformity). It is admittedly difficult to keep the time fuzes on drill projectiles in such condition that they will cut properly and consistently. Even so, effort put forth in this direction will more than pay for itself. The executive and the gun mechanic, with an improvised kit of spare parts, can accomplish much.

i. Ramming.—When serving armament that fires separate-loading ammunition, considerable stress must be laid on uniformity in ramming. The only way to get it is to ram uniformly hard, since it manifestly is not possible to ram uniformly “light” or uniformly “medium.” Moreover it is essential to guard against the projectile falling back onto the propelling charge when the piece is elevated. Make all cannoneers understand that a projectile rammed hard may seat as much as a quarter of an inch more deeply than one that is rammed “light.” This can cause a very appreciable variation in the volume of the powder chamber. That increased range dispersion is consequent to haphazard ramming should, then, be apparent to all.

j. Checks of settings and laying.—(1) Make these with suitable frequency during drill. They are useless unless unexpected. It works well, immediately after the first simulated salvo of a new drill problem, to command **AT EASE; DEFLECTIONS**; and to have corrected at that time any deflection errors found, thus getting all gunners off to an even start. At one or more other times during the problem, when the arms of all chiefs of section are raised in token of readiness to fire, command: **IN REAR OF YOUR PIECES, FALL IN; REST**. Then personally verify the laying and all settings in each section. The chief of the section about to be checked commands: **AT EASE**. The executive checks not only for accuracy but for take-up of backlash as well.

(2) Examples of the latter: Will twisting the head of the panoramic sight lightly to the left bring the vertical hair to rest off the aiming point? With the light gun, will shoving the breech to the right throw the vertical hair off the aiming point? Will downward pressure on the breech cause forward displacement of the bubble? Does the torsion applied in cutting a fuze change the settings on the fuze setter? As to each error found, explain carefully the effect it would have had on the projectile had the round actually been fired. **Caution:** Never tax a cannoneer with an error unless it is clearly apparent that he alone could have made the error. **Example:** In checking the setting of the panoramic sight, the executive touches the sight, then calls the gunner's attention to the fact that the micrometer graduation does not match exactly with the index. The gunner is very likely to harbor the mental reservation that the executive altered the setting when he handled the sight. The correct procedure is obvious. In the same connection: With certain heavy-tailed weapons such as the 155-mm howitzer, if the ground is the least bit soft, the trail (unless resting on its float) will gradually sink while the gun squad is waiting to have its work checked. Investigate this possibility before blaming the cannoneer for a forward-creeping bubble.

(3) With a well-trained battery it is possible to save a good deal of time by requiring the chiefs of section to do most of the checking, provided the executive occasionally and without warning checks the checkers and assures himself that slipshod work is not being allowed to pass. The executive should do the bulk of the checking unless he is well enough acquainted with the battery to know pretty well what to expect from each noncommissioned officer and man, and unless the battery is a seasoned, proficient organization. If these latter conditions are fulfilled, he may personally do most of the checking, and be more fully aware of what goes on, or he may have most of it done by chiefs of section and obtain a faster, snappier drill with chiefs of section feeling relatively more important. The decision as to which method to use depends also on how the battery happens to be functioning at the moment.

k. Recorder and telephone operators.—For all practical purposes the recorder and both telephone operators are key members of the firing battery and should by all means drill and train with it. In addition to being thoroughly proficient, the operators ought to be accustomed to working with each other and with the executive and recorder, for unless data transmission is smooth and entirely dependable it is a constant source of trouble. The recorder furthers the

executive's mission of catching errors *before* they are fired. His "check" is highly reassuring, both to the executive and to the cannoneer. In peace or in war a reliable recorder is invaluable. A poor one is a constant source of trouble. Although it is not difficult to train an intelligent man for this duty, you cannot select a spare cannoneer in the heat of battle and transform him then and there into a recorder. In order to have a usable recorder on hand at all times it is necessary to keep three or four men trained for this duty. These can get no better practice than at drill with the firing battery. Have a simulated OP, reasonably close to the place chosen for drill but out of sight and hearing of the gun squads, and there have the fire commands read in the desired tempo to T3.

1. *Speed*.—(1) This is *always* subordinate to accuracy. One must learn to walk before he tries to run. The battery that tries to gain speed by hurrying will never become efficient. Exhortations to the firing battery to speed up the drill are very harmful to fire discipline. Still worse is the threat that severe disciplinary action will follow errors or slowness. Under no circumstances should extra battery drill be held for disciplinary purposes. Such tactics as these bring about an error-inviting condition of tenseness in some men, while in others they arouse an indifferent attitude. They fail absolutely to get at the cause of the trouble, which is probably that the executive is not a leader.

(2) True speed is to be gained only by eliminating the lost motion. In no other way can it be had. As battery executive you become an efficiency expert, devising ways of saving half a second here and a quarter of a second there, and seeing to it that you yourself are not guilty of wasting the battery's time. Do not, for example, command: **NUMBER ONE** (dramatic pause), **FIRE**. Face toward the piece to fire and jerk your arm down the instant the chief-of-section's arm comes up. Do not permit dawdling. In moving from place to place the cannoneer does not walk nor does he double-time—he *runs*.

(3) The good cannoneer acquires his manual and mental dexterity by intelligent and persistent practice. He makes no unnecessary motions. Every motion he does make is swift and positive. He knows how many mils to the turn of his handwheel (knob, thumbscrew) and which way to turn it, applying these as naturally and instinctively as he steps off with his left foot in marching. As a simple example of this, in traversing the 155-mm howitzer to the right by about 8 mils in order to get on the aiming point, the poorly trained man will first take time out to make sure which way to turn the handwheel; then, trying to keep his eye at the sight while turning the handwheel, he

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will awkwardly complete the operation in from 20 to 25 seconds if nothing goes wrong. The good gunner takes a quick glance through the sight, observes that he must traverse to the right by about 8 mils, and reacts immediately to the fact that this will take 19 or 20 counter-clockwise turns of the handwheel. He next concentrates all his powers on making world's record time for about 18 turns of the handwheel, then applies his eye to the sight and, making the last turn or so carefully, finishes the job in a total of 8 or 10 seconds.

(4) The battery should be able to take fire commands as fast as the executive can give them and still be sure that he is both heard and understood. At such a tempo the commands **NUMBER ONE ADJUST, SHELL HE, CHARGE 3, FUZE QUICK, BASE DEFLECTION LEFT 160, NUMBER ONE, ONE ROUND, QUADRANT, 420**, can be given in about 15 seconds.

(5) In working for speed, the OP (FDC) and the firing battery being considered together, it is important that the firing data come to T2 at just the right tempo. This can be determined only by experience. Too fast a tempo is really more time-consuming than one that is unduly slow, because the executive, unable to keep up with T2 and still make his commands heard and understood, is forced to consult the recorder for the latter elements of the data. In extreme cases the recorder gets behind; then the battery stands still while data transmission is repeated. The tempo should be such that immediately T2 repeats any element of data the executive can announce it to the battery in time to complete his command just before T2 repeats the next element.

m. Voice of command.—(1) Develop your voice of command; if need be, seek seclusion and give yourself a course in voice culture. A screaming voice marks the amateur, as does overloud rendition of commands intended for a single nearby section. With experience most executives acquire a businesslike, confident tone of voice which carries and which conveys assurance to the gun squads. The responsibility that your commands are both heard and understood is largely yours. Do not conduct drill with the pieces hub to hub, giving commands in a conversational tone. Space the guns at full (or greater) intervals and thus get the men used to your commands while you exercise your voice.

(2) Enunciation is important. Pronounce numerals in the manner prescribed for telephone operators. Lest **SIXTE** be confused with **RIGHT** some prefer to say "ESS-EYE." In giving certain commands a short pause in the proper place is helpful, for example: **BASE DEFLECTION RIGHT—short pause—ONE SIX ZERO**. The pause gives the gunners

and the trail shifters time to react and thus cuts down the likelihood of false starts and errors.

(3) A system of simple and unmistakable arm signals is often useful for supplementing the voice, particularly when working in a high wind or against noise. For example, thrust the right (left) arm to the right (left) with a straight-arming motion to indicate RIGHT (LEFT); make a lifting motion above the head to signify UP; etc.

(4) School yourself always to announce "THE COMMAND WAS" before repeating any element of data for which you have been asked. Failure to do this invites the quite common error of doubling the shift or other data change.

n. Self-enlightenment.—Know your matériel thoroughly, not only the primary guns but the antiaircraft and antitank weapons, and all accessories as well. No gun mechanic, gunner, chief of section, or other member of the battery should know the matériel better than you. And you must be largely self-taught. Whenever you take over unfamiliar armament get out the ordnance handbook and study it. Put on fatigue clothes, avail yourself of whatever enlisted help you may want (gun mechanic, gunners, chiefs of section, etc.), and spend a few half-days in the park learning to service the recoil mechanisms, mount the subcaliber equipment, boresight the guns, make all authorized adjustments and disassemblies, and maintain the armament generally. Also by working with your key subordinates you will learn surprisingly about their abilities and idiosyncrasies.

o. Notes.—By all means provide yourself with a notebook. In waterproof ink keep a "permanent" section in your notebook. Record in it the serial numbers of all guns, all carriages, and all ordnance accessories (especially gunner's quadrants) that pertain to the firing battery. This will enable you, for instance, to keep the same gunner's quadrant always in use with a given gun and will serve you in other ways too numerous to set forth here.

3. Service practice.—*a. General.*—Service practice amounts to intensive training for battle. This applies not only to those few officers who fire the problems; it applies with equal force to all troops that participate.

b. Before leaving park.—(1) Learn all you can about the assignment. In particular find out about the position, the OP(s), the type of firing, the amount and kind(s) of ammunition, and the safety limits.

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(2) Set an hour for leaving park that will surely allow you time to be in position ready to fire at least 10 minutes ahead of time. A half hour is better.

(3) Check the recoil mechanisms.

(4) Boresight the pieces; either do this yourself or delegate it to a single qualified individual. If subcaliber firing is the order of the day, boresight the subcaliber tubes both vertically and horizontally and then remove the tubes for travel. In every park there should be a convenient area where the pieces can be boresighted with precision. A distant point serves the purpose rather better than the test target; however, the test target should be properly mounted and readily available.

(5) Test the gunner's quadrants. These get out of adjustment more often than one would expect, owing in most cases to rough handling and to failure to keep them clean. The method of testing and correcting an inaccurate quadrant is set forth in the Field Manuals on service of the piece. Make additional tests to make sure that all quadrants read alike at each of several elevations. The quadrant is the basis of all adjustments of range scales and range quadrants; it must, therefore, be correct.

(6) Test the range quadrants and range (elevation) scales in the manner prescribed in the pertinent Field Manual on service of the piece.

(7) Test the fuze setters for excessive lost motion and to make sure that, with the same settings, all fuze setters will cut a given fuze with the same time of burning. No tolerance should be allowed.

(8) Test all firing mechanisms, breech mechanisms, gas-check pads, etc., for proper operation and functioning.

(9) Inventory the ammunition to see that it meets the requirements as to quantity and type; spot-check it for condition. Each section should be given approximately the same quantity of each ammunition lot. If it appears that too many odd lots have been issued, report the fact and try to get the matter remedied.

(10) See that tires are inflated as prescribed.

(11) Have tools and accessories checked for completeness. In a well-trained battery with which you are completely familiar it is usually sufficient to call off the items to the noncommissioned officers and the mechanic and ask if they have them. Under other conditions you should do considerable checking in person. In any event, the checking should be done systematically.

(12) Make it a rule always to have field glasses and firing tables at the battery position. There will usually be a definite need for both. You cannot, for instance, compute the minimum elevation without a firing table (or an extract therefrom).

(13) Experience will show you various other matters that have to be attended to. It is wise to keep in the "permanent" section of your personal notebook a check list of all these matters so that none will be forgotten.

c. Occupation of position.—(1) Arrive at the position well ahead of the battery in order to determine how best to occupy it. Get the pioneer work started without delay; this consists chiefly of digging trail pits and leveling wheels. If the pieces are to be fired from the wheels, the position of each piece needs to be carefully leveled laterally and sloped very slightly to the rear. Getting both wheels accurately at the same level speeds up the laying considerably, for it permits the cross-level bubble to remain centered while traversing, and it eliminates traversing uphill.

(2) With some types of matériel, trail pits are necessary and important. The trail pit has definite shape and dimensions and is dug neither smaller nor larger than necessary. Any trail pit must bring about three conditions: that the piece will not push back out of position during recoil; that the trail can be shifted easily; and that the piece can be given the highest quadrant elevation that the assignment may require.

(3) Recheck the recoil mechanisms. Recheck also the gunner's quadrants, the range quadrants, and range (elevation) scales. Bore-sight again; do this in person, for it is highly important. Most of these latter operations can be carried on concurrently with the pioneer work.

(4) Determine the minimum elevation(s). This is always a consideration of compelling importance. It is vital when firing over friendly troops or when the mask is close. Strictly speaking, your battery is never ready to fire until you have computed the minimum elevation for every combination of charge, projectile, and fuze that you have in the position. The minimum elevation equals the greatest of the minimum elevations reported by the chiefs of section, plus the elevation corresponding to piece-mask range, plus two forks at piece-mask range, plus the number of mils subtended by 5 yards at piece-mask range. To facilitate and speed up this computation it is a good idea to prepare a set (one for each combination of charge, projectile, and fuze that can be fired by your weapon) of cards similar to the one illustrated in figure 2. To compute the minimum elevation deter-

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mine (by the best means available) the range to the mask; select the card that pertains to the ammunition combination under consideration; note the figure that appears in the total column and on the line with the piece-mask range (interpolating between adjacent lines when appropriate); and add to this figure the greatest of the minimum elevations reported by the chiefs of section. Keep the cards secured to your firing table.

Range to mask	Elevation	2 forks	5 yards	Total
100.....	-1.6	2.0	50	51
150.....	+0.6	3.0	33.3	37
200.....	2.8	4.0	25	32
250.....	5.0	4.0	20	29
300.....	7.2	4.0	16.7	28
400.....	11.4	4.0	12.5	28
500.....	15.8	4.0	10.0	30
600.....	20.2	4.0	8.3	33
700.....	24.8	4.0	7.1	36
800.....	29.2	4.0	6.3	40
900.....	33.6	4.0	5.6	44
1,000.....	38.0	4.0	5.0	47

NOTE.—A separate card should be prepared for each combination of charge, projectile, and fuze.

FIGURE 2.—Card for 155-mm howitzer; HE shell Mk I; charge 5; fuzes M46 and M47.

(5) Example: The executive commands: **MEASURE THE MINIMUM ELEVATION.** The chiefs of section report, in the order 1, 2, 3, 4, minimum elevations (actually these are, of course, sites to the mask) of 113, 112, 116, and 111. The executive determines the piece-mask range to be 650 yards. Referring to the appropriate card (fig. 2) he finds, by interpolating between 600 and 700 (and taking the next higher whole mil in case of a fraction), that the total figure for 650 is 35; to this he adds 116 (the greatest of the minimum elevations reported) and thus finds that the minimum elevation is 151. He then repeats the process for all other combinations of the ammunition on hand.

(6) Initial laying for direction is accomplished by any of the methods set forth in FM 6-40. Whatever the method, the azimuth of the initial laying should be determined as soon as possible (preferably prior to firing). Do not wait to be told to do this. Always check the initial laying by an independent means if time permits; for example, if laying was accomplished with the aiming circle, check it by referring to a distant aiming point and seeing if the referred

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deflections differ among themselves about as they should. Spot on the ground the direction of the initial laying. You will nearly always be able to do this with respect to a distant hill, a bush, a rock, or some other feature on the terrain to the front. Knowing the initial direction, you are enabled to check visually the execution of such a command as **RIGHT 180**; you simply measure 180 mils to the right, using your fingers, fist, match box, field glasses, or whatever your favorite angle-measuring expedient may be, and then glance over the tube(s) to see if they are pointed about as they should be. With practice you can, in this way, pick up an error as small as 20 mils. Require your assistant executive and all chiefs of section to make this visual check also. It is all-important because it serves to catch errors *before they are fired*.

(7) Require that the initial laying be accomplished with each piece in the center of its traverse. This insures that the sector which can be covered without shifting trail will be the same for all pieces. Moreover, with split-trail matériel all tubes will have about the same horizontal inclination to the trails, thus affording an additional visual check on the laying for direction. To expedite shifting trail with box-trail weapons, have the direction of initial laying materialized on the ground in prolongation of the trail to the rear. If and when base deflection (new base deflection) is recorded have each piece brought to the center of its traverse and relaid; then have the base line (new base line) materialized in prolongation of the trail to the rear. Spot the direction of the base line (new base line), as indicated above, for visual checking.

(8) The object of the initial process of carefully laying the pieces parallel in a known direction is to make it feasible to lay them parallel (or with a known deviation from parallelism) in any designated direction by the simple and rapid means of a deflection shift. This promotes accuracy because there is usually time both to do the work without haste and to check it by independent means; manifestly it makes for speed, for a deflection shift is by far the quickest way of giving direction to a piece. Once the initial laying is completed and the pieces have been referred you can proceed in a variety of ways. For example—

(a) You can command: **RECORD BASE DEFLECTION**. Then, when fire commands are received, you quickly determine appropriate deflection shift and command: **BASE DEFLECTION RIGHT (LEFT) (SO MUCH)**. If and when you are directed to record base deflection your command to the battery is: **RECORD NEW BASE DEFLECTION**. This procedure is open to the objection

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that changing from one base deflection to another introduces chances for error.

(b) Many prefer to command: **RECORD REFERRED DEFLECTION**, and not record any base deflection (by that name) until so directed. This is virtually the same procedure as that outlined in (a) above. It is open to about the same minor objections. Some take exception to "referred deflection" as an additional bit of terminology for the enlisted personnel to remember. Actually there is little choice between (a) and (b).

(c) You can omit requiring the gunners to record anything, merely commanding: **RIGHT (LEFT) (SO MUCH)** as soon as fire commands arrive and you have determined the correct shift. However, what if a sight setting is disturbed prior to receipt of fire commands? What if you find it expedient to have a few minutes of drill in service of the piece before the service practice begins? If so, it will be necessary to check all deflections with the recorder before announcing any fire commands that involve direction.

(9) The initial laying being completed, have the safety stakes set out under the supervision of the chiefs of section. Check their work if time permits. The safety officer has to check it anyway. In general, the more you help him, the more he will help you; and such cooperation will expedite the delivery of fire.

d. Firing.—(1) The shift from initial deflection can be handled variously. One excellent technique, applicable when the *Y*-azimuth of the initial laying is known, is to compute rapidly the *Y*-azimuth of the laying that results from the initial fire command (computation being unnecessary, of course, if the fire command for direction is: **COMPASS (SO MUCH)**). The difference between these *Y*-azimuths is the numerical amount of the shift; the direction of the shift is determinable from the fact that an increase of azimuth is a shift to the right. The following example illustrates the method:

(a) No orienting line has been established. The battery is laid parallel on *Y*-azimuth 3100 and the base (referred) deflections have been recorded. The executive has measured and recorded the *Y*-azimuths from the base piece (No. 1) to all visible aiming points that are likely to be designated. In particular, he has determined that the *Y*-azimuth of the line from the base piece to a certain lone tree is 1062. The initial fire commands include: — **AIMING POINT LONE TREE** — **DEFLECTION 1480**. The executive computes the *Y*-azimuth of this laying by subtracting the announced deflection from the azimuth (increased by 3200 if necessary for purposes of subtraction) of the line: base piece—aiming point; $1062 (+3200) - 1480 =$

2782. The shift is left because 2782 is *less* than 3100 (azimuth of initial laying). In amount it is 318 mils (3100—2782). Thus a shift of **BASE DEFLECTION (REFERRED DEFLECTION) LEFT 318** will put the direction of fire exactly where called for and with parallelism just as precise as that of the initial laying.

(b) A good variant of the foregoing is to determine the shift by comparing either *Y*-azimuths or deflections, depending on which is announced in the fire commands. It is a little faster. It is also a little more susceptible of the error of shifting in the wrong direction, since deflection and azimuth increase in opposite directions.

(c) Example: No orienting line has been established. The battery is laid parallel on *Y*-azimuth 4700. Pieces have been referred to the blockhouse on Signal Mountain and *base* deflection has been recorded, No. 1's base deflection being 3043. The executive has caused the base piece to measure the deflection to every visible aiming point that is likely to be designated. (Having No. 2 piece also measure these deflections will serve as a check against large error.) He has noted these deflections, together with the azimuth of his laying, on a small card or scrap of paper which appears as follows:

Compass	Blockhouse
R	L
4700	3043
L	R
Maunauna Marker	Tower on MacPherson
L	L
647	2379
R	R

The letters *R* and *L*, as set down on the card, afford a check against shifting the wrong way. The battery is now ready to receive data. The executive handles initial fire commands for direction as follows:

<i>Fire command</i>	<i>Executive's command</i>
Ca 4665	BDL 35
AP Blockhouse Sig Mt; Df 3125	BDL 82
AP Maunauna Marker; Df 525	BDR 122
AP Tower on MacPherson; Df 2170	BDR 209

Registration is accomplished, with only No. 1 following commands, and the executive is directed: **ON NUMBER ONE FORM SHEAF PARALLEL, RECORD BASE DEFLECTION.** He checks No. 1's current deflection and finds it to be 2914; that is, No. 1 is now laid 129 (3043—2914) mils to the right of its original base deflection. The executive commands: **BASE DEFLECTION RIGHT 129, RECORD**

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NEW BASE DEFLECTION, and spots on the ground the direction of the new base line. (Had No's. 2, 3, and 4 been following commands, sheaf parallel, throughout the registration the executive would merely command: **RECORD NEW BASE DEFLECTION.**) He now "moves" everything on his card to the right by 129 mils and is again ready for any sort of data that may be announced. His card now appears as follows:

Compass	Blockhouse
R	L
4700	3043
L	R
R	L
4829	2914
L	R
Maunauna Marker	Tower on MacPherson
L	L
647	2379
R	R
L	L
518	2250
R	R

(2) Note that either of the foregoing schemes permits the executive to use an aiming point of his own choosing (the aiming posts included) throughout the firing, no matter what other aiming point may be designated from the OP. Aside from the considerations of visibility and convenience of location, retaining the same aiming point is desirable because of *parallelism*. Throughout the delivery of fire the distribution (i. e., the proper covering of the target with fire) is based upon the hypothesis that the sheaf was parallel initially. It is for this reason that so much stress is laid upon parallelism of initial laying, and it is largely to achieve this parallelism that boresighting, laying, and kindred operations are done so meticulously. And it is obvious that, unless considerable referring is resorted to, changing aiming points will operate to throw away whatever parallelism may have been previously attained.

(3) In the first of the examples given in (1) above, the executive could have accomplished the same result by laying parallel on a known azimuth and then measuring the azimuth to that aiming point which was designated. In the second example he could have waited until he found out, from fire commands received, which aiming point was to be used before having No. 1 measure the deflection to it.

In either case such waiting would have caused the battery to exceed the time allowable for getting off the first round. To foresee the possible need and perform some work ahead of time was simply an application of common sense.

(4) In determining a deflection shift divide the operation into two separate and distinct mental processes: First decide *which way* you are to shift, regardless of how much; then determine *the amount*. Shifting the wrong way is a common error.

(5) Oftentimes the orienting line is established before the base angle can be determined and announced. In such case a good executive will, if the battery is firing, determine the base angle on which his battery is currently laid. To do this, with an instrument set up over a point on the orienting line he lays reciprocally with No. 1 and thus establishes the 0-3200 line of his instrument parallel to the laying of No. 1; using the upper motion, he then lays the instrument on one end or the other of the orienting line and reads the base angle (always less than 3200). Now, whatever base angle may be announced, it remains only to make a deflection shift. Similarly, if the battery has just arrived at the position and is not expected to fire for a few minutes, the executive should select an arbitrary base angle and go ahead with laying the battery on it. The arbitrary base angle should be so selected as to place the laying close to the center of the sector and should be a multiple of 100 mils (to facilitate mental computation of any shift therefrom). Bear in mind that a shift to the left increases the base angle.

(6) If the mission opens with an individual piece, station yourself behind that piece, the recorder and T2 accompanying you, and check its direction (also, roughly, its elevation) by sighting over the tube. You should be able to pick up any deflection error in excess of about 20 mils. If the laying appears correct, the piece fires as soon as ready. (The loss of time consequent to checking with the recorder *before* firing is not justified unless you suspect that something is wrong. In fact from where you stand you can probably see the sight plainly enough to read the deflection within a few mils.) Immediately after the piece has fired, have its settings checked with the recorder so that if there is an error it can be reported *at once*. Then check quickly the laying of all other pieces that are following data, first by sighting over the tube and then with the recorder. Both at the start of a mission and after any large deflection shift *there is no substitute for the visual check*, for the gunner may be using the wrong aiming point. This latter happens far more often than one would believe possible. It is here that an

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assistant executive finds one of his best uses, namely, to look after the visual checking of one platoon. Sometimes the first sergeant can be made available to do this. It is not a proper duty for the safety officer, who is concerned entirely with safety and not at all with errors made within the safety limits.

(7) Once in a great while, despite the wisest of precautions, an erroneous round may be fired. In such case there is only one course open to you; no matter how embarrassed you may be, you must make immediate report to the OP (FDC), stating the nature and amount of the error, and (if so) that it has been corrected. The officer firing may have based the limit of a bracket on the one bad round, making the success or failure of his adjustment entirely dependent upon it. The men must be made to comprehend this so that they will report errors immediately on detection instead of acting with normal human frailty and correcting the error without reporting it.

(8) In firing by platoon or battery neither the chief of section nor the executive should hesitate to call a piece out if there is the slightest doubt as to its laying. The best of cannoneers will make an occasional mistake. Catch these errors *before* they are fired, not after.

4. Night occupation.—a. Drill.—Never neglect an opportunity to practice occupying position at night, for it is under cover of darkness that batteries move and go into position in war. Executing these maneuvers at night involves no new principles; it is simply the strangeness of working in the dark that must be overcome. Practice is the answer. You will find that after a few sessions the men will become routined so that they go about their work in a remarkably businesslike way. Develop discipline in the matter of lights and noise right from the start. The battery that shows more than the irreducible minimum in the way of light, or that seems unable to operate without a lot of shouting and argument, stamps itself at once as one of doubtful dependability.

b. Preparatory measures.—Generally a night occupation is preceded by daylight reconnaissance and survey, at least by the higher echelons, for otherwise the battery will not be able to fire effectively until after daybreak. When circumstances are very favorable the firing battery may arrive at the position and find a guide for each section, the position for the sight of each piece marked by a stake, aiming stakes and safety stakes set out and rigged for illumination, initial pioneer work completed, data as to base angle or base deflection, and various other improvements. When the reverse condi-

tion obtains, i. e., when neither reconnaissance nor survey of any sort has been possible, the battery has to get into position as best it can, lay by compass on a known *Y*-azimuth, and proceed in the dark with the organization of the position. The usual situation is somewhere between the two. Manifestly it is advantageous to get certain key personnel of the firing battery into the position before dark. Although you, as battery executive, have no voice in the matter of who may precede the battery to position, your suggestions should be made. You yourself should get a look at the position by daylight if possible.

c. Use of instruments.—(1) In using fire-control instruments at night it is often difficult to bring into the field of view the light to be sighted. Also, if more than one light is in the vicinity, the matter of sighting the right one needs consideration and care. It is obvious, then, that in using the aiming circle to lay the battery at night it is better to work with one piece until its laying is complete than it is to follow the daytime procedure of reading on the pieces in turn and then turning back for check and recheck.

(2) This difficulty of bringing into the field of view the light to be sighted has the effect of putting a good many panoramic sights (telescopes) in the repair shop. The gunner, searching up and down (as well as right and left) in his anxiety to pick up the aiming circle (aiming post) light, continues to apply force to the elevating knob after he has unwittingly reached the limit of elevation (depression) and thus jams or strips the elevating mechanism in the tilting head. With the 105-mm and 155-mm howitzers, and with various other weapons, this difficulty can be surmounted as follows: Train the gunner to keep his tilting head set always at zero (300 with some sights), day or night, until by rotation of the entire sight mount he has the aiming point (light) in his field of view and centered vertically therein, then to operate sight mount and tilting head in opposite directions, keeping the aiming point (light) centered in the field of view, until the sight mount has been rotated back to its proper position. The same procedure lends itself very well to accomplishing large changes of elevation with the 155-mm howitzer and with other weapons of similar design.

d. Night lighting devices.—(1) The newer weapons are equipped with excellent night lighting devices. Some of the older ones have none at all. If your battery lacks any or all of these devices you should start improvising at once. A surprising amount can be done with a little wire, a few cigar boxes and tin cans, and some flashlight batteries and bulbs. The use of flashlights themselves in making

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settings and centering bubbles is inconvenient and slow. The matter of lighting the aiming posts and safety stakes is a fertile field for ingenuity. In a really elaborate set-up each piece might have lights of a distinctive color, the one on the far-aiming stake being placed higher than that on the near stake so that misalignment will become readily discernible, and the whole system powered by a central battery or generator, thus permitting the position to be lighted or darkened by the flip of a switch. This system introduces numerous wires around the position, which will be hazardous in the dark and which will probably short-circuit in wet weather. The simpler the system the more reliable it will be.

(2) Another method is to tape ordinary flashlights, of the pattern having the beam at right angles to the barrel, to the various stakes. The excess brilliance can be dimmed by covering the lenses or by removing the reflectors. (The scheme of using a distinctive color or system of colors for each section is a good one and should be followed when possible.) Under this arrangement it is necessary to send men out to the front to turn lights on and off. This takes a little time and introduces an additional safety precaution, for you may not fire until each chief of section has reported that all of his men are safely in rear of the guns.

(3) The kerosene aiming lamp (aiming lantern M2) is entirely satisfactory. Various expedients that use lanterns or candles will work. It would seem advisable to have both electric and kerosene lights, one system being auxiliary to the other. For unless it runs out of aiming points the field artillery can distribute explosives, in the blackest of nights, when and where they belong.

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BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

E. S. ADAMS,
Major General,
The Adjutant General.

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